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First published 1984

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Foreword

This Report is one of a series dealing with health and safety developments in various industries. The food industry employs in its manufacturing processes nearly 500 000 people and is an industry which is subjected to constant change as consumer taste demands. The success of any enterprise can often be measured by its ability to manage the changes which are forced upon it and changes in manufacturing processes and techniques bring about different health and safety problems to be dealt with.

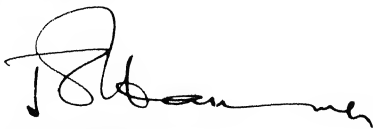
The need to manage the health and safety problems in a positive way in the food industry is much the same as in any other industry. Since the introduction of the Health and Safety at Work etc Act 1974 (HSW Act) there has been a requirement on employers to produce health and safety policies which outline the objectives to be achieved, detail the organisation and responsibilities within the company, designed to achieve these objectives, and set out detailed arrangements by which the policies are to be implemented. Where a company conducts all its operations on one site the management and monitoring of safety is much more easily controlled than when the company operates in a diverse field at a large number of different locations. Within the food industry there are a number of very large companies which operate at a large number of sites, where they conduct a wide variety of processes and the problems of ensuring that the safety policy formulation by the Board is implemented properly in all these locations is a constant problem for many of these companies. There are, unfortunately, still instances reported within the food industry where large companies have not fully got to grips with the problem of ensuring a uniform standard of safety performance at the various different locations and in their various operating divisions.

Most experienced inspectors feel that they can get a good assessment of a firm's commitment to health and

safety by the first impression that they gain when entering a factory. Dirty, untidy factories tend to be unsafe and unhealthy factories, since the dirty, untidy nature of the premises usually is an indication of sloppy management. In the food industry, however, this is not always the case. Food factories tend to be very much cleaner than most other factories and the initial impression that is gained is one of order and good management. The standards of cleanliness which are usually apparent to meet the needs of food hygiene legislation do not always mean that the factory will be safe, since as the report points out that food industry has a particularly difficult task to ensure that the needs of both safety and hygiene are met. The report indicates how diverse some of these problems are and some of the ways in which the industry has responded to the challenge.

Throughout the report reference is made to the work undertaken by a large number of trade associations representing the employers in the food industry. Since the National Industry Group (NIG) was established, a considerable amount of work has been done by joint working parties representing employers, machinery manufacturers and trade unions on which the Health and Safety Executive has been pleased to be represented. While some of the working groups have disbanded after their particular task was completed, others have a continuing commitment to review developments within their industry and the spirit of co-operation in health and safety matters, which has been achieved by the existence of these various bodies, has been encouraging.

I am pleased to present this Report and hope that the food industry will be alert to the lessons which can be learned from it.



J D G HAMMER
HM Chief Inspector of Factories

Introduction

1 The Food and Packaging National Industry Group (NIG), now based in Glasgow, covers all aspects of food processing and production from the time the raw material leaves the primary producer until the product is ready for despatch to the final consumer. It covers the production of food for animals as well as for human consumption and because the food industry is one of the largest users of packaging equipment, its responsibility also extends to various packaging processes.

2 The food industry is in reality not one, but a conglomeration each with its own particular processes and problems so far as health and safety is concerned. Some sectors, like flour milling, are old established

traditional industries which have developed gradually throughout their long history, but other sectors do not have such long traditions and are developed to meet changing tastes and consumer demand. In some areas the health and safety problems of one sector of the food industry have little relevance to the problems of other sectors, yet the lines of demarcation are far from clear, since most plant and equipment and processes will be used in more than one sector of the industry so there is a need to ensure that experience gained in one area is made available wherever such plant and processes are used.

Some common problems

Food hygiene

3 One problem common throughout all sectors of the food industry is to reconcile the apparently conflicting requirements of food hygiene with the health and safety of those who work in the industry. Food processors are generally more conscious of their responsibilities for food hygiene but with a little planning and forethought, the needs for both food hygiene and operator safety can be satisfactorily met.

Machine guarding

4 When dealing with food processing machinery, hygiene will usually demand that all parts of the machine can be properly cleaned, and this will often involve exposing dangerous parts. Normally this will mean the removal of guards so the establishment of safe procedures for cleaning is absolutely essential. In the food industry it is certainly not sufficient only to safeguard a machine to enable it to be operated in a safe manner. The safeguards must also enable the machine to be cleaned in a safe manner and the process of cleaning should be seen as an integral part of the operations to be carried out at the machine. The provision of a safe cleaning procedure is just as important as the provision of a safe operating procedure and adequate training of personnel engaged in hygiene operations is essential.

Interlocking

5 In many instances guards must be interlocked with the power source for the machine, to enable proper isolation to be achieved. Isolation of the machine along with the use of notices to indicate that isolation has taken place, before cleaning is started should always be the rule, but it is almost impossible to ensure that routines are always observed for jobs done on a regular basis so in order to achieve safety during cleaning a high standard of interlocking of guards is necessary.

6 However when interlocking arrangements are provided the operator may rely on the interlock for his safety. It is therefore necessary to ensure that the standard of interlocking system is capable of withstanding the constant removal and replacement of the guard. The interlocking arrangements should also be so designed as to make interference by the operator difficult because of the constant temptation to clean a machine while it is in motion.

Electrical standards

7 Interlock switches may have to be placed in positions where they will be exposed to water as a result of the cleaning operations. It is essential in these circumstances that the equipment is properly installed, earthed and maintained and is adequately protected

against water entry. BS 5490/1977 specifies the degrees of protection afforded by enclosures and any equipment installed should be of a standard appropriate to the risk, e.g. classification IPX5 would be needed for protection is against penetration by water jets. In addition BS CP 1014/1963 gives advice on protection of electrical equipment against climatic conditions. The electrical hazard can also be reduced by having interlock switches working at extra low voltage, i.e. a voltage not exceeding 50V AC or 120V DC whether between conductors or to earth.

8 Apart from electrical equipment, parts of the electrical installation of the factory itself may also be exposed to wet conditions and it is not uncommon to find electrical equipment loosely wrapped in some form of plastic sheeting in a mistaken belief that this will in some way afford real protection against water entry. Makeshift arrangements of this type should never be tolerated, and the equipment should either be re-located to a position where the hazard does not exist or replaced by equipment specially designed to protect against the risk. While there is no substitute for safe equipment, properly installed and maintained, coupled with the use of correct procedures, some additional protection can be provided, especially for portable apparatus, by the provision of a residual current device (formerly known as a sensitive current-operated earth-leakage circuit breaker).

Transport

11 Transport accounts for a significant proportion of the accidents in the food industry. Many could be avoided by giving greater attention to the well known hazards associated with the use of the large variety of vehicles and other forms of transport used within the industry. The HSE Report *Transport Kills* refers to a number of problems and their solutions.

Road vehicles

12 Road vehicles are present in many food factories and unfortunately many of the older food factories do not have roadways designed to cope with the volume of traffic using them at the present day. Such roadways should be wide enough for the safe movement of the largest vehicles using the premises and special consideration must be given to the very large articulated vehicles which are now in common use.

13 The management of vehicle movements is a topic which should receive as much attention as any other management problem to ensure that there is (a) maximum separation between road vehicles and

Floors

9 The apparent conflict between safety and hygiene is also demonstrated when one considers the number of accidents due to slips on the same level. Wet, slippery floors are a constant hazard in food factories by the very nature of the material being processed. This is often aggravated by the provision of a very smooth tiled surface for easy cleaning. The choice of flooring material all too often meets only the needs of hygiene and does not adequately take into consideration the need for safety. In the meat industry the spillage of small amounts of fat, coupled with the general damp environment, makes the floor as slippery as a skating rink. Floors in some factories can become so slippery that it is difficult to walk across them in safety and the time saved in cleaning processes must be lost several times over in the difficulties in movement across the floor for ordinary production purposes. Slip-resistant surfaces may be more difficult to keep clean but a reasonable compromise must be reached and the food industry should be prepared to accept an increase in cleaning time to effect a reduction in accidents caused by excessively smooth floor surfaces.

10 In some areas of particularly high risk, e.g. where sharp-edged tools are used, and at the operating position of band saws, at least the small area of the floor used as a work station should be constructed to a high standard of slip resistance, even although this necessarily means that the time taken to ensure cleanliness will be much greater.

pedestrians using the factory premises, (b) proper sign-posting of internal roadways, (c) adequate precautions to deal with blind corners and (d) appropriate measures to ensure that the speed of vehicles within factory premises is restricted and controlled.

14 The reversing of vehicles within factory premises does present special problems especially with large and articulated vehicles. The arrangements for the movement of vehicles should be designed to ensure that reversing of vehicles is minimal. Some reversing will be necessary, especially when vehicles have to be accurately positioned at loading and unloading docks. Where possible the area should be clearly marked and should not be used for movement of internal transport or by pedestrians.

15 The most important precaution to be taken during reversing, however, is the provision of a signaller at the rear of the vehicle. Where the drivers of contractors' vehicles are unaccompanied, the occupier of the factory should provide a signaller to ensure that the driver is able to reverse in safety.

16 Accidents also happen during loading and unloading operations. The Association of British Abattoir Owners have recently published advice to their members on the precautions necessary during the loading and unloading of meat designed to take into account the special handling problems in their industry. A number of serious accidents also occur from falls from the vehicle or its load particularly during sheeting operations where drivers are standing on top of the load handling heavy tarpaulin sheets. Some companies have provided special sheeting gantries to try to make this work safer but there is still considerable scope to improve the safety of this operation. Where bulk tankers are used they can eliminate the risks associated with manual handling of the product but there is a need to ensure good safe access for personnel who have to climb up on to the top of the tank. Progress in this field is being made by the provision of wide catwalks together with a collapsible handrail which can provide a good handhold. It is hoped that as tankers are renewed, access to the tops of tanks will gradually be improved.

Lift trucks

17 The problems associated with the use of lift trucks and some of the precautions which should be adopted are well covered in the Health and Safety Series booklet HS(G)6, *Lift trucks*. Apart from the general use of lift trucks in the food industry, however, there is increasing use of lift trucks in cold stores. There have been failures where cold embrittlement of the metal may have been a factor. The arduous conditions of use of such trucks may need to be taken into consideration when deciding the level of maintenance and inspection.

18 Lift trucks are generally used with pallets and racking. There have been a number of incidents where purpose-built racking has collapsed due to inadequate bracing and inadequate design. Even when the racking itself is strong enough to take the imposed loads, it often does not have sufficient decking to adequately support the pallets which are placed on it. Although the supports along the face of the racking may be adequate, it is not uncommon to find no supports from back to front which results in bending of the pallets. The poor design of racking is in many instances responsible for the damage done to pallets and it is not uncommon to find large numbers damaged in warehouse areas. Quite apart from the possibility of the

loaded pallet failing a number of injuries are caused by the handling of damaged pallets. While many firms have a good routine for the inspection and repair of pallets, more effort put into the prevention of damage would in many cases mean a much lower repair bill.

Pallet trucks

19 Where it is not necessary to raise or lower palletised material, but only to move the pallet at or near floor level, it is common to use power-driven pallet trucks. On many of these pallet trucks the only wheel which is driven or braked is the single wheel at the front of the truck near the operator's position. There have been a number of accidents with this type of truck where the powered wheel has run over the foot of the operator. The fact that braking is only applied to one wheel makes this type of truck more difficult to control especially in the food factory environment where the floor can become slippery. While proper training procedures are now common for lift truck drivers, pallet trucks appear to be operated without the same control. Proper training for their operation is just as important as for the more sophisticated lift truck.

Non-powered transport

20 While many serious injuries and some spectacular accidents may be caused by powered transport, the number of accidents due to non-powered transport is disturbingly high. When wheeled trolleys, tubs and racks are used for the movement of materials within the factory, it is usual for the wheels to be mounted on castors and to be of comparatively small diameter. While it is common to find sophisticated maintenance procedures laid down for powered transport the simple non-powered trolley and rack appear to get no maintenance at all, in many factories. With very small diameter wheels it is necessary to ensure that the floors are kept free from pot holes and other obstructions which will affect smooth passage. The trolleys can be loaded with considerable weights and because there are no brakes on such vehicles, can be very difficult to stop. The maintenance of castors is of prime importance. One damaged castor can make vehicles of this sort very difficult to control. It is encouraging to note that some manufacturers of wheeled trolleys and racks are now fitting much larger diameter wheels to their products and this, along with proper maintenance will go a long way towards avoiding these accidents.

Refrigeration

21 Although gases such as Freon have gained popularity in recent years, extensive use is still made of ammonia as a refrigerant. Ammonia, apart from being toxic, can form an explosive mixture with air. The dangerous properties of ammonia should be carefully considered in the design, maintenance and operation of any refrigeration plant using ammonia as a refrigerant.

22 There were reported to one Area Office recently, a number of serious leakages of ammonia, one of which involved an explosion. The Inspectors in that Area decided to pay close attention to the precautions being adopted in all the ammonia refrigeration plants visited to assess whether or not the precautions being adopted were satisfactory.

23 The results of this survey as reported below were rather disturbing, and further enquiries are being made.

Location of plant

24 The ideal location for an ammonia compressor house would be in an open-sided building well remote from the main factory, but unfortunately many compressor houses are situated within factory buildings. Where this is the case, there should be the maximum separation between the ammonia compressor house and production areas. Where an internal door is essential, a self-closing device should be fitted and the door should open outwards from the compressor house.

Respiratory protective equipment

25 Where maintenance work has to be carried out it is necessary to ensure that respiratory protective equipment is available and used where a release of ammonia is possible. Most of the factories visited did in fact possess canister respirators for maintenance work. In the vast majority, however, the canisters were overdue for replacement and no-one was carrying out monthly inspections to ensure continuing serviceability. In view of the limitations of canister type respirators, it is normally recommended that two sets of self contained breathing apparatus should be kept available for rescue purposes and that there should be an adequate number of people on each shift trained in its use. In very few factories were the recommended standards being met.

Explosion risk

26 It is essential to minimise the risk of ammonia leakage by proper plant design, installation, operation

and maintenance. Even with the best run plants however, leakage can occur and suitable measures need to be taken to cater for such an event. Because of its characteristic smell, in compressor houses which are continually manned any small leakage of ammonia should be detected easily and the attendant should be able to shut down plant before a major escape has occurred and there is any likelihood of accumulating a flammable ammonia/air mixture. Continuously manned compressor houses are however rare, and as plant is generally either unmanned or only intermittently manned, reliance cannot be placed on manual isolation of plant as a primary means of protection.

Ventilation

27 It is of primary importance that compressor houses are provided with adequate permanent ventilation to safely dilute any ammonia leakage which may occur. A number of compressor houses visited by the survey however, had only minimal ventilation in many cases relying on opening windows which would normally be closed for security purposes at the end of the working day. In such cases modifications (e.g. the incorporation of louvred openings etc) were necessary to achieve at least the standard of ventilation specified in BS 3343: Part 1: 1980 *Requirements for Refrigeration Safety*.

Sources of ignition

28 Appropriate measures are necessary to ensure the absence of ignition sources (e.g. plant incorporating naked flames etc) from compressor houses. For non-explosion-protected electrical equipment (compressor motors etc) it may in the case of continuously manned compressor houses be possible to rely on rapid manual isolation in the event of an ammonia leakage.

29 In completely unmanned compressor houses, protection may be achieved by installing explosion protected electrical equipment but due to a high cost of this equipment, this method of tackling the problem is very rarely adopted.

30 An alternative approach is to install ammonia detection equipment which can either sound an alarm (in cases where, although the compressor house is not continually manned, the factory is continually manned), or automatically shut down the equipment. Three-quarters of the factories visited with unmanned or intermittently manned compressor houses had no ammonia detection equipment installed.

Drainage of vessels

31 At the installation involved in the ammonia gas explosion the leakage of ammonia occurred when oil was being drained from a vessel and the valve was not closed in time to prevent the escape of ammonia gas. In many cases it was found that when oil had to be drained from small pots at the base of bulk vessels there was a facility to isolate these pots from the

remainder of the system. Where this facility does not exist the drainpipes should either be extended to a safe position in the open air and/or fitted with an additional automatic closing spring or weight loaded valve downstream of the normal drain valve.

32 The indication from this rather limited inquiry is that both industry and the Inspectorate will need to give greater attention to the safety of this type of plant in the future.

Health problems

33 The food industry does not have the health problems of many other of industries, but nevertheless the NIG, in conjunction with the Employment Medical Advisory Service (EMAS)* have had to consider a number which have come to light.

*On 1 June 1983 this became the Medical Division of HSE.

Safety of additives

34 Many manufactured foods have various materials added to them to improve the keeping qualities of the product. The nature and amount of additives which may be used are strictly controlled by law although the controls which are imposed are designed to ensure that there is no risk to any person eating the product in which additives or preservatives have been used.

35 Concern was expressed by a trade union that the additives used in the manufacture of bread might be affecting the health of the employees in the baking industry. Consequently enquiries were made into the nature of the additives which were in common use and into the methods by which they were handled. An examination of the methods by which the additives were received and handled in a typical bakery indicated that the additives concerned were received pre-mixed with soya flour, producing a rather sticky powder, which, when handled, did not create any significant level of dust. In the few instances where the additives were undiluted none were likely to give rise to dusty conditions.

36 The only reported instances in which the handling of additives could have been a contributory factor were a small number of nose bleeds. These, however, may arise for a number of reasons e.g. as a result of allergic rhinitis or straightforward irritation by dusts, so it was impossible to identify whether or not any particular dust could be held to be primarily responsible. On the evidence available at present it would appear unlikely that the use of additives in baking would represent any real health risk.

37 There was also information from the American Food and Drug Administration on the possible carcinogenic effects of nitrosamines synthesised in the gut from nitrites contained in some meat products.

This caused some concern for the health of workers who handle large quantities of nitrite.

38 An assessment of the situation in several meat factories was carried out and the general consensus of the Employment Medical Advisers was that the basic compounds would be unlikely to be absorbed by those handling these materials, and that there was no real cause for concern.

39 In provender manufacturing concern has been expressed about the number of veterinary drugs which are handled for the formulation of special feeds. It is common for a wide variety of additives to be mixed in with the animal feed stuff and in many cases the effects of these substances on the operators are not clearly understood, since they are often drugs which are used only for the treatment of disorders in animals. There is, in many cases, a lack of clear knowledge about the effect of many of these substances on human beings and it is therefore necessary to ensure that there is a high standard of industrial hygiene practice where such additives are manipulated. Until fairly recently it was uncommon to find exhaust ventilated booths available for the manipulation of these additives prior to their addition to the animal feed, but concern about this problem in the industry has been such that the provision of dust control for the manipulation of these chemicals is now becoming much more common.

Meat wrappers asthma

40 Reports were received from America of allergic and irritant reactions in workers wrapping food in plastic film. A review of the literature was undertaken

by EMAS. The literature search indicated that the problem was extremely complex and that the symptoms could range from apparent asthmatic effects to irritation of the eyes in workers handling a variety of plastic materials.

41 It has not been possible to identify cases in the United Kingdom. It is, however, quite common for plastic film used to wrap food products to be cut using a hot wire rather than a mechanical knife and it is known that if wire is too hot the plastic film will not only be cut, but will give off various fumes, which can be very complex, depending on the nature of the plastic. Provided, however, the heated wire is not hot enough to cause decomposition it is considered that the likelihood of problems is small.

Prawn peeling

42 Reports were received from one factory where the peeling of prawns was carried out, that several employees were complaining of asthmatic type symptoms.

43 The peeling of prawns has traditionally been done by hand but in recent years, there has been a movement towards blowing out the proteinaceous material from the shell by using either air or water. It was found that in the room where the prawns were being peeled there was a fine mist in the air and that, when air blowing was being carried out although the proteinaceous material was apparently intact, many small particles became airborne. Tests indicated significant airborne concentrations of proteinaceous material. Since no problems had been reported in factories using hand peeling, machine peeling, or water blowing, it appeared likely that the asthmatic reaction of persons employed in air blowing was due to the inhalation of this material.

44 A special enquiry was mounted into the methods of prawn peeling throughout the country and a total of five factories were identified where air blowing of prawns was carried out. In all these factories there was further evidence of asthmatic reaction.

45 There appeared to be little commercial advantage in air blowing and all five factories have now reverted to water blowing. No problems have been reported.

Ornithosis

46 In the past, psittacosis, a viral illness which may show gastro-intestinal or respiratory symptoms, has been known to be passed to humans from cage birds such as parrots and budgerigars. Gradually it was realised that similar diseases could be contracted from other birds and the more general term 'ornithosis' was employed.

47 In 1974, approximately 114 of the 1000 employees of turkey-processing plants in three American States, suffered an illness, of which the main symptoms were severe headache and pneumonia. Investigations showed that this was an ornithosis.

48 A report was received in March 1980 of a woman with a severe pneumonia-like illness thirteen days after she had bought four dressed ducks. In February of that year a poultry meat inspector in the same area was found to be suffering from ornithosis.

49 Further investigations by the local Microbiological Laboratory revealed that five other cases had occurred between November 1979 and March 1980. All those involved had been handling ducks.

50 Tests showed that those handling ducks in the various stages of processing were more likely than the normal population to show antibodies to the virus; it was postulated that such a response was more common among eviscerators than in other process workers.

51 As it is not possible to eradicate the disease from flocks of birds bred for the table, and a vaccine to protect humans is not available, control of the disease, (which may range from a mild cold-like illness to a near-fatal pneumonia), can only be achieved by careful attention to personal hygiene, and by the wearing of suitable protective clothing by process workers.

52 It is essential that employees should be fully aware of the risk and be provided with a medical contact card so that they can alert their doctor in the event of any of the symptoms of the disease becoming apparent.

Animal by-products industry

Centrifuges

53 The bursting of revolving vessels has been recognised as a serious hazard for many years. The Animal By-products industry uses centrifuges as a means of separating usable from waste products. There

have been a number of very serious accidents (including a fatality) caused by parts of the machine becoming dislodged when the machine was revolving at high speed.

54 The fatal accident arose because a circlip-type retaining ring intended to keep the removable basket

top firmly in its place became detached from the basket groove, so releasing the loose top and wrecking the cover locking and clamping arrangements. The circlip emerged while still rotating, with the basket, and partially-straightened, through the gap left by the partial opening of the hinged cover. Some of the basket contents also emerged, but not, as has been known to occur, the basket loose top itself. In other incidents, when the circlip ring had detached from the basket groove it almost invariably resulted in the wrecking of the cover interlocking arrangements, distortion of the hinged cover, breaking of the single clamp holding the cover down and the violent ejection or partial ejection of machine parts and basket contents.

55 The machine was designed so that, unless the retaining ring was fully expanded into the basket groove, and the locking bolt properly inserted between its ends, it should not be possible to close the hinged cover. An interlock ring on the underside of the cover was provided and intended in such circumstances to prevent the closing of the cover by fouling the top face of the locking bolt tail. In use, the centrifugal forces of the machine would tend not only to keep the ring in position, but to further expand it. Consequently, most cases of ring detachment were probably due to other factors (such as excessive wear on the basket register, or the periphery of the basket loose top, or excessive ovality of the basket register so that the ring could be insufficiently within the groove at some point, or excessive dishing of the loose top), often in conjunction with adverse conditions of use or misuse. Such factors could lead to the locking ring rolling out of, or being stripped out of the basket groove, despite being fully

extended under the heavy hydraulic upward thrust caused by operation of the machine.

56 The machine manufacturers recognised the effect on safety that excessive wear could have and had issued comprehensive instructions to users on how to check their machines for wear. They had given very precise limits beyond which the machines should not be used. It was evident however, that these instructions, although comprehensive, were not always being followed by the users, and in many instances, the users of these machines did not have sufficient engineering expertise available to carry out the type of check recommended.

57 Because of the continuing accidents at this type of machine, it was felt at one stage that the only method by which operator safety could be secured would be to house these machines inside a strong brick enclosure with a suitably heavy steel interlocked door, so that, in the event of such failure the parts of the machine ejected during failure would be contained.

58 The manufacturers however intensified their efforts to find a technical solution to this problem and were able to develop a new multiple clamp for a replacement casing cover which proved to be satisfactory in service.

59 A programme of special visits was undertaken during 1980 to all known users of this type of fat extractor who were not known to have fitted the new type of cover. As a result of that action, all the machines in use, had or are having satisfactory modifications carried out.

Bakeries

60 The baking industry has undergone a period of change in recent years. With the demand for the traditional loaf declining and the emergence of hot-bread shops the traditional pattern has altered, resulting in the closure of a number of plant bakeries and the withdrawal of one of the major groups from the baking industry. This has happened concurrently with a wider range of fancy breads being offered by hot bread shops and in-store bakeries.

61 There has been for some time a well established Safety in Bakeries Liaison Committee which includes representatives of the Federation of Bakers; the National Association of Master Bakers, Caterers and Confectioners; the Cake and Biscuit Alliance; the Process Plant Association; the Bakery, Food and Allied Workers Union and the Health and Safety Executive. This Committee provides a useful forum for the discussion of safety and health problems throughout the baking industry as a whole.

Ovens

62 In large plant bakeries where travelling ovens are used, it is necessary from time to time for a person to enter into the oven for the purpose of clearing a blockage or effecting emergency repairs. Under these circumstances it may not be economically practicable to wait until the oven has cooled to what would be regarded as a normal working temperature and the conditions under which entry should be permitted was considered by the Safety in Bakeries Liaison Committee.

63 There was considerable difficulty in trying to draw up safe working procedures for such an eventuality, and the recommendations made were regarded as the best advice that could be given in the light of current knowledge. The advice given was that (a) the person entering the oven must be physically fit (b) overalls that

are light and loose fitting and made of cotton drill should be worn and heat resistant gloves should be worn (c) the temperature inside the oven should be recorded by a black globe thermometer or an ordinary thermometer with 2°C added to the reading (d) a continuous flow of fresh air should be maintained through the oven by fans and adequate local lighting provided so that the person inside the oven could see what he was doing (e) at least one other person should be present to assist the person inside the oven (should he be overcome by heat) who should maintain visual contact with him at all times (f) a plentiful supply of a saline drink should be available and (g) no entry should be permitted if the temperature was greater than 46°C. At that temperature it was considered that the maximum period that a person should spend in the oven should be 10 minutes and a table was drawn up giving increased permitted exposure as the temperature cooled down.

64 The system of work to be used in connection with the advice should be in accordance with a written permit-to-work system. So far the advice appears to have worked satisfactorily. Nevertheless EMAS suggests further research to establish acceptable exposure times in hot work.

Rotating table pie and tart machines

65 Machines of this type are used throughout the baking and meat manufacturing industries for the production of pies and tarts. They normally consist of a rotating table onto which are fixed the appropriately shaped moulds and after the dough to be moulded is placed in the mould it is indexed round to the pressing head at the rear of the machine. The principal danger with type of machine is of fingers being trapped between the pressing head and the mould and in this respect the machines are as dangerous as pressing machines used in other industries. A Health and Safety Guidance Note on this machine is in preparation.

66 To prevent access to the trapping point it is usual for the rear part of the rotating table to be guarded with fixed and interlocked guards to enclose the pressing head and with interlocked and trip guards above the front of the table where the feeding of pieces of dough and removal of the moulded pie or tart shells takes place. Because the moulds on which the dough is placed stand proud of the indexing table, there is always a gap between the bottom of the guard and the rotating table and a number of accidents have occurred where persons have been able to put their hand below the guard. "False tables" to fill in this gap were produced for many machines of this type; this filling-in

effectively prevented access to the pressing head. The system was perfectly satisfactory when properly used and maintained but it was found in practice that even where false tables had been provided, they were not always replaced after being removed for cleaning and occasionally became bent and distorted in such a manner that either they allowed access, which they were intended to prevent, or started to foul the guard and were therefore removed. A number of accidents still occur because the front guard is not kept properly adjusted and the gap between the guard and the false table is excessive.

67 To overcome some of the disadvantages presented by the use of false tables, the major manufacturers of this type of equipment altered their approach to the prevention of access at this point and are now providing safety frames to match each set of dies. The frames consist of an inner ring at the centre of the rotating table and radial webs which are in line with the edge of the guard when at the operating position. The edge of the guard which meets the safety frame has been developed as a trip flap so that if a person's hand was caught by the safety frame as the table indexed forwards, it would meet the trip flap on the guard and effectively stop the machine before the operator could reach the danger area between the pressing head and the mould.

68 Where a trip flap is employed, however, there is a need to ensure that the engineering is good so that it does in fact operate when it is needed. It is essential, for example, that the movement should positively operate the switch to cut off the power from the machine and there should be no possibility of slackness or malfunction in any of the connections between the trip flap and the interlock switch.

69 In certain cases, where users have converted their machine from false-table protection to safety-frame protection, there has been a lack of appreciation of the essential differences in the method of achieving safety. It is essential to ensure a minimum clearance between the safety frame and the trip flap, to achieve the standard of safety which is necessary.

Reversing dough brakes

70 Reversing dough brakes consist of a horizontally mounted pair of rollers through which the dough is passed, from one side to the other during processing.

71 In recent years conveyerised dough brakes have become increasingly common whereby there is a belt conveyor on each side of the pastry rollers. This type of machine offers a significant advantage to safety because it is not necessary to push the dough in

towards the inrunning nip of the rollers. Guarding of this type of machine is also fairly straightforward, with an interlocked tunnel provided with an opening for the entry of the dough at sufficient distance from the nip to ensure that access to the inrunning nip is not possible.

72 The more traditional type of dough brake does not have a conveyor feed but has a fixed table on either side of the rollers with the dough to be processed being pushed in towards the rollers by the operator. On this machine the guard provided is normally of a type whereby movement of the guard upwards will not only stop the rollers but cause them to reverse. The guard is used not only for safety but as a means of controlling the motion of the rollers.

73 The guard is often connected through a link to a clutch in the main drive. It has been noted, however, that on such machines with a mechanical clutch the rollers do not always stop instantaneously when the guard is raised, but continues to creep; this overrun can be sufficient to allow fingers to be drawn into the nip of the rollers. Regular maintenance is necessary to ensure that the performance of the guard is up to the standard originally designed.

74 The standard of performance for this type of guard is well known and has been available in Technical Data Note No 49 now replaced by HS(G) PM 35 for some considerable time. It is found in practice, however, that accidents are usually caused by lack of maintenance and lack of routine checking to ensure that the guard is still working in accordance with the specifications required. Checking of dough brake guards by using a tape measure is laborious but it can be checked more conveniently by using a gauge made in accordance with the table published in the

guidance notes. This gauge can be kept at the machine and the operator can easily check whether or not the guard is working according to required specifications by raising the guard of the machine to the point where the rollers stop and then inserting the gauge on the table of the machine to see if the end of the gauge will touch the roller. If it does, the guard performance is below standard. (see Figs 1 & 2)

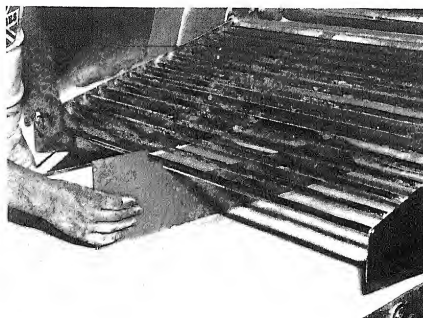
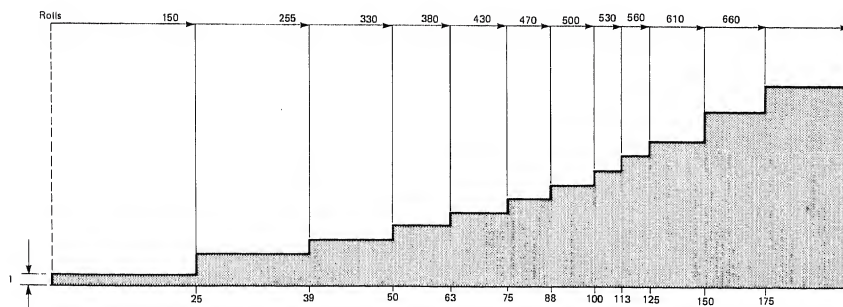


Fig 1 Use of a gauge to check the performance of the guard on a dough brake

Fig 2 Dimensions of a gauge which can be used for checking the performance of a reversing dough brake. The guard should be raised to find the position at which the roll stops. If the gauge, when placed on the machine, can touch the rolls, the guard performance is below standard



Flour silos ladder access

75 Many bulk flour silos installed at plant bakeries are between 14 and 15 m in height. It is usual for a permanent steel ladder to be provided to give access to the top of the silos and in most cases the ladders have hoops of the standard pattern.

76 While it is now usual to provide landing places at approximately 10 m intervals, many ladders provided in the past did not have this facility.

77 As a result of discussions as to how the access to the tops of silos could be improved, it was found that a resting stage could be installed in existing ladders consisting of a sheet metal back rest fixed inside the access ladder back hoops so that a person ascending or descending the ladder could at that point rest his feet on the ladder rungs and lean back safely onto the back rest.

78 Whilst this type of resting place does not give quite the same standard of safety as the landing places, which are seen on more modern installations, it does give a means of providing a safe resting place at very modest cost and this idea could usefully be used for access ladders other than those in bakeries.

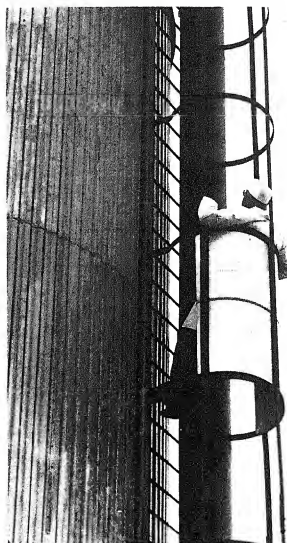


Fig 3 Ladder access on a flour silo, with plated area at the hoops to form a resting place

Mixing machines

Planetary mixing machines

79 Planetary mixing machines or whisk machines are used for making light mixes. They have in the past generally been small, low-power machines and because there was no history of serious accidents, guarding for the beaters was not normally required. The size and power has gradually increased over the years and it was considered appropriate to review the pattern of accidents to assess whether or not there was any need for a change of policy on necessary precautions.

80 During 1980, factory inspectors investigated all accidents reported which were associated with them and the reports were studied to see if any pattern could be identified.

81 In that time, only five accidents were reported, two occurring while ingredients were being added with the machine in motion; one, while the operator was testing the mix with the machine in motion, and two due to inadvertent starting of the machine during the cleaning operation.

82 Three of the accidents caused total disablement of less than 10 days, but one resulted in a broken finger and the other in a broken arm and wrist. All occurred at medium-sized machines.

83 These accidents have to be viewed against the estimated 100 000 machines of this type in use in British industry. Because of the low accident rate and the high cost of providing guards it is considered that the problem can probably be dealt with by improved training of the operators, especially on proper isolation before cleaning.

Double-arm mixing machines

84 Double-arm mixing machines are a traditional machine in the baking industry. The action of the machine arms is designed to simulate that of the arms of an operator mixing the dough. There have been serious accidents due to trapping between the kneading arms, and the provision of guards has been common for many years although on older machines the standard of interlocking was unsatisfactory. Disturbingly, there have in recent years been a number of accidents due to operators reaching over the interlocked guard into the arm-rotating mechanism; on some machines the interlocked guard is too low, and allows this type of access. The major manufacturers and importers have been gradually improving the standard of guarding on new machines over a number of years and the standard currently available is now very high.

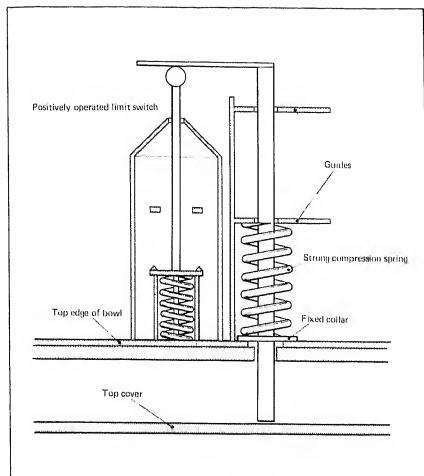


Fig 4 Interlock system for high-speed mixer, showing bowl lowered and contacts broken. Diagrammatic arrangement, not to scale

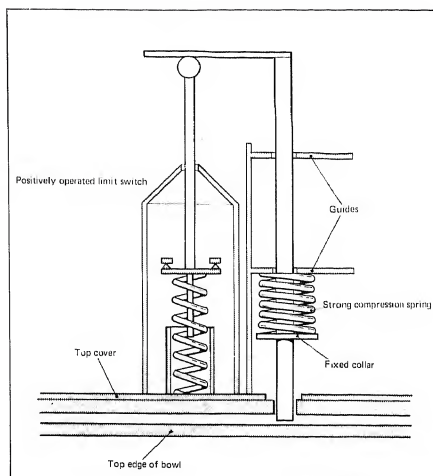


Fig 5 Interlock system for high-speed mixer, showing bowl raised and contacts made. Diagrammatic arrangement, not to scale

Spiral-arm mixers

85 Spiral arm mixers have been introduced into the baking industry steadily over the past few years and are now widely used. The spiral mixing arm presents a serious trapping risk especially on those mixers which have a central pillar in the mixing bowl. This type is normally provided with a guard over the top of the mixing bowl which is suitably interlocked with the machine drive. A number of manufacturers however provide a much larger than necessary opening both in the main guard and at the front of the bowl. Any such openings should be of the minimum size necessary to enable the baker to test the mix or add additional ingredients but should not allow easy access to the trapping points particularly between the rotating spiral arm and the central pillar in the mixing bowl.

High speed mixers

86 Because of their higher speeds and considerable power, high speed mixers present a considerably greater risk than other types of removable bowl mixing machines. They have a bowl which is mechanically raised towards the mixing head; there must be a trip device at the mixing head so that a person's hand cannot be trapped between the bowl and the mixing head as it is being raised. Until the bowl is in position, it does not effectively guard the mixing blades and beater, so arrangements have to be made to ensure that the blades cannot be set in motion before the bowl is in

position. The bowl therefore forms a removable guard for the blades; the interlocking of a removable guard is always more difficult than the interlocking of a hinged guard. This problem is increased when there are a number of bowls. In some earlier designs interlocking was attempted by using non-positively-operated limit switches so that in the raised position the bowl depressed the stem of the limit switch thereby allowing the machine to run. This type of interlocking is however prone to failure if the springs in the limit switch fail and is also liable to unauthorised interference since hand pressure on the switch will simulate the presence of the bowl.

87 Careful thought to the design of the interlocking system can however overcome many of the problems and a good standard of safety achieved by having probes located at either side of the machine which are raised against compression springs by the top edges of the bowl. These probes can be designed to operate positively-operated limit switches and the ends of the probes can be slightly pointed so that unauthorised interference by hand pressure is most unlikely.

Bread slicing machines

88 Machines used to slice bread normally consist of a series of vertically mounted reciprocating knives through which the loaf of bread is passed by means of a conveyor or other pushing device.

89 Machines of the type used in large bakeries deal with many loaves every hour and the feed to the slicing blades is normally by means of two side conveyors, which grip the ends of the loaf and push it through the blades. This type of machine is usually provided with interlocked guards at the feed side to ensure that there is no access to the cutting side of the blades.

90 The trend towards more bread baking being done in hot-bread shops and in-store bakeries has created a demand for slicing machines of much lower capacity than those used in the main bakeries. Machines used in these establishments tend to be smaller and less sophisticated. In some cases those dealing with the medium range of production still feed the bread to the slicing machine by means of two side conveyors but because of the smaller capacity, it is not usual to have interlocked guards at the feed side but to protect the feed side of the blades by means of a fixed tunnel. This should extend at least 1000mm out from the danger point and means should be provided for pushing the last loaf through the cutting blades, since the side conveyors are unable to do this.

91 Smaller machines still, designed primarily for retail operations, are designed to cut only one loaf at a time. The loaf is pushed through the cutter blades by a manually-operated pusher block and on many designs of machine the dimensions and position of the block are insufficient to prevent access to the cutting surfaces of the reciprocating blades. An interlocked guard should be fitted at the feed end to ensure that the cutter blades cannot be set in motion unless the guard is closed. It can often be mechanically linked to the pusher so that the guard is opened as the pusher is retracted to take a fresh loaf and is closed by the movement of the pusher block towards the blades.

92 Bread-slicing machines create crumbs which fall downwards and are collected towards the base of the blades. The guarding arrangements for these machines must take into account the need for cleaning them away. Access for cleaning should either be by means of an interlocked guard, or by fixed guarding with a captive type of tray or drawer which will remove the crumbs but which will still prevent access to the dangerous parts.

Provers and coolers

93 In recent years there have been a number of accidents, including fatalities, at provers and coolers. As a result the safety of this type of plant was considered by the Safety in Bakeries Liaison Committee and the recommendations in paras 95-98 were made.

94 The main matters of concern were standards of guarding and interlocking of the main driving

mechanism and conveyors, dangers from access to the interior of the prover or cooler and from openings in the casing swing access to a trap between the trays or carriers and the framework.

95 There is a wide variation in the arrangements for securing the side panels of the plant; since access may be needed from time to time certain panels should be designated and marked as access panels and provided with interlock devices to prevent access while the machinery is in motion. The other panels, which are not interlocked, should be positively locked or secured in position by means requiring a tool for their removal or trapped in position until an interlocked panel has been removed.

96 Entry into a prover or cooler should be in accordance with a properly drawn up and controlled safe system of work and the use of a written permit-to-work system is strongly recommended. As well as positive isolation of the power supply, a person should be stationed outside the prover or cooler at all times when someone is inside and visual contact should be maintained.

97 Where access is provided in a prover to the trays or carriers, there is a possibility of trapping either between the tray and the framework or between passing trays, if ascending and descending trays are not effectively separated.

98 Because access is essential it is not possible to fence the opening. The Liaison Committee therefore published a detailed specification for safety trip bars for this type of opening. The trip bar has to operate effectively if a person becomes trapped and yet not interfere with the normal operation of the plant. The trip bar should also bring the machine to rest before it has reached the end of its travel.

Dough-moulding machines

99 The rollers of dough moulding machines have been recognised for many years as a dangerous part of machinery and the traditional methods of safeguarding them are well known. Access has been prevented by a swan neck feed hopper, or by a captive flap feeding device, whereby the dough is placed on a flap which is forced down under its weight and brings into position another flap, which prevents access to the rollers.

100 Several cases came to light at one particular type of dough moulding machine, where the flap device provided by the manufacturer had been removed. Investigation indicated that the device had been removed because it created difficulties in production when the machine was being used to mould small pieces of dough for buns; the weight of the dough being

placed on the flap was inadequate to force the flap downwards. The only answer which the operator could find was removal of the safety device. Clearly, the safety device in this instance was unsuitable for the type of work being done at the machine. It was found that the job could be speeded up quite considerably without interference with the safety device, by providing a circular hole in the second flap of the flap feeding device, allowing small pieces of dough to be fed directly into the rollers but still preventing hand access.

101 Problems have arisen recently with dough moulding machines imported principally from the Continent, where the manufacturer has not provided the type of safety device normally accepted in the United Kingdom, but has provided at the edge of a very short feed hopper, a trip bar, which when operated will stop the rollers relatively quickly. Trip bars can, however, only be regarded as a satisfactory alternative to fixed guarding if they arrest the motion of the dangerous parts before it is possible for trapping to occur. This type of device is unsuitable in these circumstances.

102 Problems have arisen with French stick moulders, where in some cases no guarding whatsoever had been provided for the moulding rollers by the manufacturer. Even although the configuration of the rollers at a French stick moulder is different from conventional machines, secure fencing can be provided either by

fixed guarding with a short feed conveyor or by variations on the flap feeding devices.

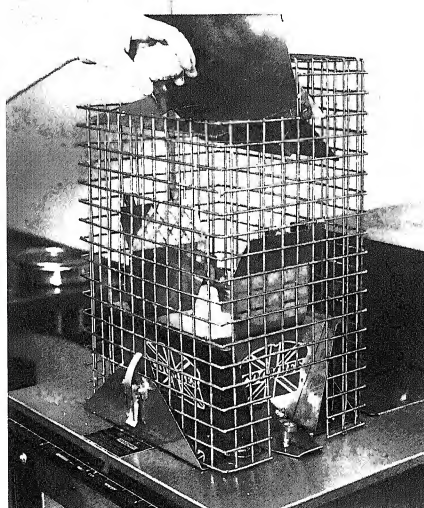


Fig 6 Flap-type guard for a dough-moulding machine, modified for easier moulding of buns and rolls

Butter and cheese packing

103 The Association of Butter and Cheese Packers, with the Association of Cheese Processors, formed a joint working party to consider the safety of many of the more specialised items of plant and equipment used in their industries.

104 Much of the development work to provide information for the working party was carried out in the factories of the firms represented in the working party and these firms willingly made available to their colleagues the expertise and design information which had been gained in their own work-places.

105 Machines which have caused particular problems are butter blenders, vacuum packing machines used for the packaging of cheese, and cheese portion wrapping machines.

Butter blenders

106 The prevention of access to the dangerous traps formed by the beater blades at tipping blenders has been a matter of some concern to the industry since many of these machines are not fitted with lids.

107 The operator must not be able to reach the trapping points at the blades when the machine is tilted to the discharge position; it is necessary to move the blades under power to assist in the discharge of the blended butter. Where the blender discharges directly into an extruder safety during discharge can be achieved by means of fixed guards but when it discharges into a trolley, have to be made to interlock the presence of the trolley with the discharge of the blender.

Cheese portion vacuum packing machines

108 A number of accidents have occurred at this type of machine, particularly at the forming head, where the plastic film is formed into pockets to receive the portion of cheese. This part is particularly difficult to safeguard because of the deep pockets which are formed in the plastic film which makes it difficult to provide fixed guarding of adequate length when there is no film in the machine.

109 It was found by one company that access to this trap could be made extremely difficult by fitting a

number of loosely-fitted plates assembled together on a spindle across the discharge area. These plates came within 12 mm of the bottom of the filling area and were restrained to prevent movement back into the forming area and not allowed to move above the horizontal position. This prevents an operator reaching, inadvertently, into a danger area. To obtain access it is now necessary to raise each individual plate separately and hold them up.

110 At another company trials were carried out using a trip device. The trip plate was arranged to rise in sequence with the forming mechanism and on meeting an obstruction to cause the forming mechanism to stop and reverse before trapping could take place.

111 Both these devices were trying to deal with a hazard left in the machine by the manufacturers. Since the problem only arises when no film is in position one manufacturer is now developing a machine in which the forming head will not move unless there is film in

position, and this is a better way of tackling this problem.

Processed cheese portion wrapping machines

112 This type of machine is complex, with a number of mechanical hazards at the reciprocating parts of the rotary table of the machine bed and the forming mechanism, and with the additional hazard of hot processed cheese burning the operator. Work was carried out by one of the member companies to find a solution to the problems, the guarding which they provided is of the interlocked enclosure type. The configuration of the machine and the openings necessary for the feeding of labels and delivery of the finished product presented many problems in designing a guarding system which did not interfere with the machine's capacity.

Cake and biscuit industry

113 A working party formed by the Cake and Biscuit Alliance representing users, manufacturers of plant, trade unions and HSE was formed to consider the safety of some of the items of plant used. So far, codes of practice have been published dealing with high-speed mixing machines and travelling band ovens.

High-speed mixing machines

114 The type of machine used for the preparation of the stiff dough used for biscuits, was dealt with briefly in HSW booklet No 26 Safety in the Use of Biscuit Making Machinery. It presents considerable hazards, particularly at the discharge stage when, because of the stiff nature of the dough, it is necessary to run the machine. Some factories still relied on a two-button control system, while in others with different discharge arrangements it had been found practicable to provide a higher standard of protection. The working party recognised that at best two-hand control systems can only give protection to one person and there could well be others at risk. The code of practice published by the Cake and Biscuit Alliance provides much more comprehensive guidance on the standards which can be achieved at these machines.

Travelling band gas ovens

115 Serious explosions have occurred in the type of gas-fired oven used in the biscuit industry. The problem with the box ovens used in the baking industry has been well documented, and standards have been

published for some time; however, there has been a lack of attention to ovens used in the manufacture of biscuits and packaged cakes.

116 This type of oven can be extremely long and there is normally a travelling band which divides it into two chambers. The travelling band may be of wire mesh or steel plates.

117 The traditional type of flame failure devices and flame protection devices applied to the box oven cannot always be applied to the multi-burner type used in the biscuit industry. It was therefore necessary to draw up guidelines to prevent explosions and to minimise their effects.

118 Whilst the standards of gas installation and of explosion relief have improved steadily over the years, there are still older ovens which have a long useful life ahead of them. Therefore the working party had to give advice on ovens which could not readily and economically be brought up to the modern standard. The Code of Practice published by the Cake and Biscuit Alliance gives advice on how explosions can be avoided and on how to minimise the effects if one occurs.

Ice-cream cones and wafer machines

119 A study was undertaken by the NIG on the safety of machines used to manufacture ice-cream cones and wafers. These machines usually comprise pairs of moulds which are supported by guides and carried through an oven on roller chains. The moulds are

opened and closed by cams adjacent to the conveyor track and batter is injected into the moulds through moving or fixed nozzles, which are supplied by a pump. Dangerous traps can be present as the moulds close.

120 While it is possible to safeguard modern high-speed machines with fully-interlocked guards, problems were encountered in achieving an acceptable standard of safety on some of the older machines, where,

because the moulds are not plated, batter was prone to stick to the moulds. Access was therefore necessary for greasing the moulds, for brushing them to remove surplus or burnt batter, and occasionally to assist the discharge. On machines where fully-interlocked guards were not practicable, a higher standard of safety could be achieved by providing a number of fixed guards together with trip wires or trip bars at the points where access was necessary, with training for the operators.

Confectionery

121 There is a large number of different machines now in the sugar confectionery industry, but there is no clear pattern of accident causation.

122 Toffee-pulling machines are fairly commonly found in confectionery factories. They comprise two arms rotating about a fixed arm, to pull the toffee to aerate it and change its structure. There have been several serious accidents and at least one fatality.

123 The methods by which toffee-pulling machines can be safeguarded were described some years ago, (Volume 25 of *Accidents* gave details. As the magazine is now out of print, copies of the article can be obtained from the Food NIG). In one major holiday resort where a number of rock manufacturers had their premises, inspectors found that none of the toffee-pulling machines in the town were guarded.

124 There was strong resistance to the practicability of guarding, largely based on the contention that toffee essence had to be added during the pulling operation and that guarding would make this more difficult. It was also claimed that to make the lettering for the

rock, part of the pulling has to be removed and if the machine had to be stopped, there was a strong possibility of the entire pulling falling from the machine; it was further contended that the machine was not dangerous.

125 Experience elsewhere in the country indicates that other manufacturers producing similar products have guarded their toffee-pulling machines and are able to work with the interlocked guards quite successfully, without undue interruption to production, or deterioration in the quality of the product.

126 Therefore, a letter was sent to all the confectionery manufacturers in the area using this type of machine, setting out the reasons why guarding was necessary and giving advice on the standard of guarding which should be provided. The results have been encouraging, with several machines now fully guarded for the first time, with other firms having placed firm orders and with Improvement Notices being used to ensure that all firms are treated in a similar manner.

Dairy industry

127 The dairy industry in the United Kingdom is probably unique in continuing to provide a service of daily deliveries of milk on the doorstep. About 85% of the liquid milk in the United Kingdom is sold in recoverable glass bottles and many of the safety and health problems of the dairy industry result from the need to handle, clean, fill and distribute vast quantities of glass bottles every day. A typical medium-sized dairy can handle a quarter of a million pint bottles every day.

128 The Dairy Trade Federation representing the occupiers of dairies, along with the Process Plant Association representing the major machinery suppliers, have had for some years a joint working party to consider how best to safeguard the major items of plant used in dairies and have, with the Health

and Safety Executive, prepared a number of codes of practice to provide guidelines for machinery suppliers and users of existing plant.

Bottle fillers

129 The first code of practice dealt with bottle fillers, including integral cappers and crowners. Bottle fillers are now available which can run at up to 600 bottles per minute and even at much lower speeds there are a number of danger points on these machines, which have caused accidents.

130 A typical bottle filler has a worm feed or similar device to separate the bottles on the infeed conveyor, and present them properly spaced to a star wheel for

feeding onto the pedestals at the filling tank. Traps can exist at the worm feed and also between the rotating star wheels and fixed structures. As the bottle on its pedestal is raised towards the filling head of the filling tank there are traps formed at the pedestal lifting or depressing cams and between the pedestal and fixed structures. When the filled bottle is removed from the filling pedestal there is a danger point as the formed foil cap is placed on the bottle top and further traps at the sealing head assembly as the bottle is again raised on a pedestal for the foil cap to be sealed to the bottle. Other danger points exist at the capping press, where the strips of aluminium foil are formed into caps for presentation to the bottle.

131 It was concluded that safety could best be achieved by fixed and interlocked guards which enclosed the whole machine enabled necessary adjustments to be carried out while the machine was stationary. Because of the continual hazard of broken bottles in a machine of this type, the guards must be designed to enable fragments of glass to be cleared away without jamming on the guard and causing possible malfunctions.

132 This code of practice has been well received in the dairy industry and also in other parts of the food industry using similar types of machine.

De- and re-craters

133 De-crating machines are used to remove the empty bottles from the crate and place them on a conveyor for presentation to the bottle washer; re-crating machines perform a reverse operation.

134 These machines also have many trapping points, which cannot readily be safeguarded by means of fixed guards. There is always a temptation for the operator to reach in while the machine is in motion to rectify any faults due to a bottle becoming misplaced. Apart from the usual mechanical trapping points present on a machine of this sort, when a malfunction does occur there is a risk of severe lacerations, from broken glass. As with the bottle fillers, the working party recommended the provision of guards which will totally enclose the operating parts, so that access for rectifying faults can only be gained through an interlocked section of the guard while the machine is at rest.

Conveyors

135 The handling of such a large number of bottles and crates every day requires a high degree of mechanisation and the dairy industry uses a wide variety of

conveyors, to ensure a smooth flow of bottles and crates. The working party has recently been considering the safety of conveyors and a further code of practice is to be published shortly.

Noise

136 The handling of many bottles at high speeds creates noise in the bottling hall of a dairy. Efforts made by individual dairies to reduce the noise level have not been completely successful. It was therefore decided that further research was necessary to identify more clearly the sources and to find solutions. At present the noise exposure level in most bottling halls will exceed the 90 dB(A) equivalent continuous noise level which is recommended as the maximum in the Health & Safety Executive's Code of Practice for Reducing the Exposure of Employed Persons to Noise.

137 Because the results of any research into bottling hall noise in dairies could have application outside the dairy industry, the HSE has entered into an agreement with the Dairy Trade Federation for a research project to be undertaken by the Wolfson Unit of the University of Southampton. The initial part of this research project has been completed, but further research work will be needed on possible methods for reducing the noise at source.

138 The conclusion reached so far is that the main source of the noise is impact of bottles between other bottles against other bottles or against mechanisms designed to marshal them into an orderly fashion. They become mixed up at the marshalling table at the in-feed to the bottle washer thereby producing a lot of impact noise. There is often a back-log of bottles between the bottle washer and the bottle base scanners and filler, and they have to be sorted out mechanically into single file. Bottle to bottle contact noise is generated at the marshalling table before the bottles are presented to the re-crater for filling back into the crates for delivery. Thus, although the bottles are delivered in an orderly fashion by the machinery they often become mixed up in a noisy way before they are fed into the next machine.

139 Because of the nature of the noise it is unlikely that acoustic treatment of the bottling hall structure will be a cost effective method of achieving noise reductions, but tests are already being carried out on the possibility of providing acoustic covers which satisfy both acoustic and operational requirements on the noisier parts of the bottle line. A more desirable solution to the problem, however, would be to reduce the bottle impact noise at source by controlling the bottle flow more closely so that bottle-to-bottle contact did not occur.

140 In many existing dairies the elimination of bottle-to-bottle contact will not be practicable without considerable alterations to the design of the equipment and the flow of bottles through the line, so in the short term it may still be necessary to rely on acoustic covers and the wearing of hearing protection.

Milk roundsmen

141 The Health and Safety at Work Act (HSW Act) applies not only to people employed in fixed establishments but also to peripatetic workers. The problem of ensuring their safety is much greater than for those working in permanent work places where the hazards can be more clearly identified and where management supervision is more readily available.

142 Milk roundsmen constitute a large body of workers within the food industry; they spend most of their working day unsupervised and away from their operating base. The dairy industry has taken a positive approach and has made real efforts to discharge the duties placed on it to ensure the safety at work of its roundsmen.

143 As in many fields of health and safety where the risks cannot be satisfactorily reduced by physical precautions and detailed systems of work, attention has to be given to improving the training of the people involved and increasing their awareness of the hazards and of the action that they can take to reduce them. Conventional forms of training are only possible when large numbers can be brought together for formal training; the structure of the dairy industry with its

multiplicity of small units scattered throughout the country makes this approach unsatisfactory.

144 To cope with this problem, the Dairy Industry Training and Education Committee in conjunction with the Food, Drink and Tobacco Industry Training Board has produced a health and safety training package to enable training to be done even by small employers. The package contains three modules, one each for the trainee, the manager and the trainer, illustrated throughout with cartoons.

145 The trainee's module consists of four booklets designed to be self-teaching. The benefit of this approach is that trainees can work through the material at their own pace. The booklets cover such subjects as hazardous depot surfaces, handling and disposal of broken or contaminated milk bottles and driving and handling the vehicle. Use of test sheets provides confirmation that the training material has been worked through effectively together with a record of the level of achievement of each trainee.

146 The manager's module provides details of the hazard areas covered by the package and contains a questionnaire and check list enabling him to identify the facilities and equipment which he should provide if the training and subsequent practice are to be carried out effectively.

147 The trainer's module provides a comprehensive guide to the application of the teaching material. It includes recommended training time, copies of the appropriate trainee response sheets and test answer sheets, including a marking guide. The use of standardised test material ensures a consistent level of achievement across the industry and allows standard objectives to be included.

Edible oil industry

148 Following reorganisation of the HSE and the formation of inspection groups dealing with specialised industries over larger geographical areas, the reports of events in particular processes have been amalgamated, making trends more readily identifiable. Certain patterns are starting to emerge from the available data. One such concerns the failure of glass reinforced plastic (GRP) vessels in the edible oil industry.

149 The data currently available is limited principally because the failure of a GRP vessel was not reportable to HM Factory Inspectorate prior to 1981, regardless of the damage. Only if an employed person was injured to the extent that he was off work or incapacitated for more than three days would the failure be notifiable. As from 1 January 1981 the Notification of Accidents and Dangerous Occurrences Regulations have changed that situation and many of these incidents are now

reportable to the HSE as dangerous occurrences. Over the past few years, nevertheless, several incidents involving GRP vessels have been investigated by the Factory Inspectorate following informal notifications by factory occupiers, reports in the press, or on local radio stations. Clearly, only the more spectacular events are newsworthy and it is reasonable to assume that the known instances of failure form a relatively small proportion of the overall picture.

150 One HSE Area has documented six catastrophic failures of GRP vessels in the past six years, together with information about a much larger number of lesser incidents. Catastrophic failure in this context means that the vessel has ruptured almost instantaneously, normally with the loss of a significant proportion of its contents. Of the known incidents in the Area, only one caused injury to personnel, but there is little doubt that

catastrophic failure could result in serious injury to persons working on site and to the public as the following narrative by one inspector indicates.

"At about 8.45 am on Monday morning a 40-tonne capacity GRP storage tank collapsed in a factory spilling about 30 tonnes of acid oil. As the tank disintegrated it damaged the outlet connection on another tank and pushed a third tank into the bund wall, fracturing the brickwork. Approximately 20 tonnes of oil escaped from the damaged outlet and a total of about 50 tonnes of hot acid oil flowed out of the breached bund, through the factory yard and on to two adjacent streets in an industrial area close to the city centre, damaging property, vehicles and blocking drains. These streets remained closed to traffic for two days during the cleaning up operation. No personal injury was caused by the incident."

151 In other recorded cases, sections of the vessel walls have blown out with loss of contents; one vessel tore apart at the junction between the base and lower wall and one split at the bond where a metal pipe entered the vessel. More recently a 25-tonne tank tilted to one side, damaging a heating coil inlet flange at its base when GRP sections bonded to the main body of the vessel sheared allowing one side of the vessel to drop through the supporting structure.

152 GRP has been regularly used as a structural material for storage tanks and vessels for at least 20 years. Its properties of light weight and corrosion resistance make it an attractive alternative to steel for many industrial applications. In the early days when GRP was being used for storage tanks, there were no universally accepted standards to which these vessels could be manufactured. Various empirical standards were devised for design prior to the adoption in the United Kingdom of those contained in BS 4994:1973, *Vessels and tanks in reinforced plastics*. The vessels failing catastrophically during the past six years included examples designed and built before and after the introduction of BS4994; in most cases the vessels failed within their designed life expectation. One vessel recently failed only two years after construction, another after eight years, each of these having a designed life expectancy of at least ten years.

153 The causes of these failures are diverse and at the present time not fully understood. GRP is still a relatively new material so far as its long-term stability and strength is concerned. Clearly it is not homogeneous in the way that steel might be considered to be, being virtually a hand-made fabrication of thermosetting plastic resin reinforced with glass fibres arranged in a combination of forms as a chopped strand mat, woven rovings or as wound filaments. The ratio of resin to glass varies from the inner surface of the vessel, where there is a resin rich area for resistance to chemical attack, to the outer surface, which will

have more glass fibre for strength. This variation in composition indicates one area of potential failure if the design criteria are incorrect or the manufacturing specifications are not closely followed during all stages of construction. Such information as is available at the present time however, shows that the construction of vessels is by no means the only factor influencing tank life and failure potential. In some of the reported incidents it was possible to make an assessment of the conditions under which the vessels had been operated, showing significant deviations from those specified in the original order placed with the manufacturers.

154 A typical example was the discovery, after a failure, that a thermostatically controlled valve on a heating coil had broken down some unspecified period before the collapse of the vessel and was bypassed by plant operators who then controlled the steam flow manually, with no indication of liquor temperature. It is probable that the liquor temperature in the vicinity of the heating coil approached boiling point whereas the specified maximum operating temperature was considerably lower. Resins exposed to temperature in excess of that for which they have been specified may be subject to premature failure. On another occasion the occupiers found that severe degradation had occurred in a number of tanks, all but one being replaced by new vessels. The remaining vessel was temporarily derated in capacity by about 40% to reduce the stresses on the walls, until it too could be replaced. After it collapsed it was discovered that operational problems had occurred on the new tanks and that the quantity of oil stored in the old one had exceeded the derated volume. When the tank failed the quantity of oil in it was less than the designed maximum, but 50% greater than that which the users had decided was a safe operating volume. Each of these cases indicates a serious discrepancy between the standards that senior management thought were in operation in their establishment and the true shop floor practice.

155 Obviously most materials will degrade with time. GRP is no exception, the rate of loss of strength depending on factors such as temperature, duty, environment and stress. Under some adverse conditions, an operational life of five years for a steel vessel may be regarded as being perfectly satisfactory but the onset of ultimate failure in that case is usually well signalled by leaks, obvious corrosion, discolouration etc, thus giving time during which preparations can be made for remedial action. GRP on the other hand is less susceptible to the normal type of inspection and when failure occurs it is often catastrophic with little external evidence of the incipient collapse.

156 The National Industry Group is well aware that problems associated with the failure of GRP vessels is not unique to the food industry and that very large

numbers of tanks in a wide variety of plastics are used throughout manufacturing industry, many holding more hazardous materials than those normally associated with food products. At this stage it is not possible to quantify the potential hazards nor to offer specific advice about their control other than the exercise of responsible management in relation to supervision in the design, construction, maintenance and operation of GRP vessels. To increase knowledge and understanding of the problems associated with the use of all types of plastic tanks the HSE inspection programme for 1981, included collection and examination of information about the failure of plastic tanks in all industries. Inspectors throughout the country dealing with the food industry have been making enquiries about any such failures that are coming to their

attention and welcome the cooperation of industry in this exercise.

The Chemical National Industry Group will be analysing the results of industry wide investigations, but will also be carrying out a much more extensive exercise in chemical factories where there is a much greater utilisation of plastic vessels and probably a larger number of tank failures. This will obviously provide a much wider base of information on which advice and guidance can be based. It is with interest that the Food NIG is co-operating with the Chemicals NIG and looking forward to the outcome of its examination of the hazards, risks and precautions associated with the use of plastic vessels.

Flour milling

158 The principle of self-regulation which was strongly recommended in the Robens Report, was not new to the flour milling industry. The National Joint Industrial Council for the flour milling industry is now more than 60 years old and for many years the Committees of the NJIC dealing with safety, health and welfare and the Committee dealing with fire precautions and dust explosions have been active in promoting better standards of safety and health in the flour milling industry.

Safety training

159 When the Safety Representatives and Safety Committees Regulations were introduced the NJIC, with the help of the training adviser of the National Association of British and Irish Millers, introduced joint employer/trade union 3-day courses for the training of safety representatives. These courses were not limited to the training of the safety representatives appointed by the trade unions but were also available for the training of management representatives and enabled both management and trade unions to come together in a joint exercise to ensure the total involvement of both sides of the industry in trying to achieve better standards of safety and health. These courses were arranged by the Joint District Councils of the industry, and following the success of the initial three-day courses the NJIC is now proceeding to organise further one-day refresher courses aimed specifically at the hazards which have been highlighted by analysis of the accidents reported to the NJIC by the industry.

Forklift trucks

160 In recent years the NJIC has, with the co-operation of the firms in the industry, compiled comprehensive accident statistics so that they could highlight areas where attention was needed to improve performance. One area which was highlighted was the number of accidents due to the use of forklift trucks and as a result the Safety, Health and Welfare Committee issued guidelines on the safe operation of forklift trucks and a recommended training programme for operators. The guidelines recommended that only those forklift truck drivers who had been suitably trained and tested and had been issued with a Certificate of Competence should be allowed to drive forklift trucks in members' premises. The indications are that these recommendations have received good support from within the industry and following this publication the industry has seen a 50% reduction in accidents involving forklift trucks.

Transmission machinery

161 The modernisation of the industry so that machinery is driven from individual electric motors, rather than through belts and pulleys from line shafting, has made a considerable difference to the accident rate from contact with transmission machinery. There are, however, still a number of mills where line-shafting is extensively used and in these mills there is a continuing need to mount and ship driving belts while the machinery is in motion. This type of work can only be done by machinery attendants, appointed under the Operations at

Unfenced Machinery Regulations 1938, who have been sufficiently trained in these operations and who are acquainted with the dangers from moving machinery which can arise in such operations. Because of the need to make use of the provisions of these Regulations in a number of mills, the National Association of British and Irish Millers has drawn up a training programme for machinery attendants to try to ensure that persons appointed to this work are properly trained in the correct method of doing the job and are acquainted with the hazards associated with the operations. Each year there are a small but steady number of accidents associated with the mounting and shipping of belts and stricter adherence to the industry's own guidelines would go a long way to reducing accidents from this source.

Roller Mills

162 Detailed recommendations have also been issued by the NJIC giving advice on guard protection for roller mill nips and for safe operation in general. Despite this there are still accidents which is disturbing because the appropriate precautions are well known.

Dust explosions

163 Grain and flour dust have long been recognised as being capable of forming explosive mixtures with air and the risk of a dust explosion is ever present in the flour milling process. There have been very serious explosions in flour mills in the United Kingdom and recently there have been reports of serious fires and explosions in flour mills abroad. Serious explosions in the industry are comparatively rare, but this risk cannot be ignored and constant attention is needed to keep the risk as low as possible.

164 As a result of the industry's own concern for this problem, the Fire and Dust Explosion Committee of

the National Association of British and Irish Millers has produced an advisory booklet *Dust explosions in flour mills and bulk flour containers* giving examples of measures that can be taken to minimise the risk of an explosion occurring and giving advice on the fitting of explosion relief. Although the last revision of this booklet was published in 1973, most of the advice contained in it is still basically sound. Difficulties have, however, arisen over the interpretation of the advice contained in the booklet when considering existing plant in old buildings, where there are considerable difficulties in providing explosion relief panels to the standard recognised as current good practice. The recent good record of the industry in this field is due to the effort put into the prevention of explosions, since the standard of explosion relief which it has been possible to provide in some older plants might not, in fact, be adequate to completely relieve the pressure which could be generated in an explosion within the plant.

165 Agreement has recently been reached with the National Association of British and Irish Millers that the booklet should be revised in the near future; it is hoped that a clearer distinction can be made between advice on existing plant and on good practice for new plant. Whereas the cost of modifying existing plant can be exceptionally high, when new plant is being installed the additional cost of providing good standards of explosion relief can be comparatively modest and this money, if properly spent, will be a good investment.

Starch milling and handling

166 An incident occurred in a corn-starch handling plant, when an explosion injured several men by flash burns and caused considerable structural damage. An HSE report *Corn-starch dust explosion at General Foods Ltd., Banbury, Oxfordshire, 18 November 1981*, gives an account of the cause and effects of this incident.

Fruit and vegetable canning

167 The fruit and vegetable canning industry is smaller than other sectors of the food industry, but the range of processes carried out and the range of plant and equipment used is very large.

168 The Fruit and Vegetable Canners Association have had for a few years a working party with representatives from the major canning firms, the machinery suppliers, the trade unions and the HSE to consider the safety of the plant and equipment used.

Filling and closing machines

169 The first Guidance Note published by the Association on the safeguarding of machinery for processing fruit and vegetables dealt with the problems of can filling and closing machines. The high speeds at which modern filling and closing machines are run makes it essential that there is a high standard of guarding provided for operator safety, not only in the

normal running of the machines but also when rectifying faults and undertaking maintenance work.

Preparation machinery

170 A second Guidance Note dealing with a wide range of preparation equipment has also recently been

published. In the fruit and vegetable canning industry much of the machinery is used on a seasonal basis and can lie idle in the factory for several months at a time. It is therefore essential with a machine of this type that before it is brought back into service, it is properly checked to ensure that it is working correctly and that the required safety devices are in order.

Grain handling

171 Fine dust from grain may be flammable and/or explosible. Grain normally has such dust entrained with it and while the dust and grain are together there is no risk of an explosion. However, the dust may separate, become airborne particularly during transfer operations and form a flammable cloud. Such airborne dust readily escapes from plant which is not dust-tight; it can then settle again and accumulate. Any substantial accumulations within the building, sufficient to create a flammable cloud on resuspension, can cause an explosion severe enough to destroy the building.

172 Friction between grains as they are conveyed can create more dust, especially in pneumatic conveyance systems. Consequently, there may still be a risk with grain from which the entrained dust has been extracted.

173 In December 1977 in the USA, there were four serious explosions in large capacity grain handling and storage plants which caused 50 deaths and which extensively damaged the buildings. These incidents follow a long history of similar explosions of varying severity, e.g. between 1958 and 1978 there were 168 dust explosions in grain handling plants in the USA.

174 There have been no similar accidents in Britain, but it was felt prudent to examine the standard of precautions being used to prevent dust explosions and minimise their effects in grain handling plants in GB. While the risk is considered to be greater when handling finely ground material, the experience in the USA clearly demonstrates that the handling of whole grain also presents substantial risk.

175 During 1981, Inspectors were asked to visit the largest grain handling installation situated within their area and to report on the standard of precautions. The aim of the exercise which covered both old and new installations, was to indicate whether there were additional reasonably practical measures which could be taken to further reduce the risk.

176 The reports indicated that in all cases the management were fully aware of the risk and in most

cases were trying to take appropriate steps to control it. Even in old installations, much can be done to prevent the escape of dust and to remove the accumulations which do occur; the reports indicated generally a high standard of cleanliness. The elimination of potential sources of ignition by keeping strict control over for example welding operations can be achieved without any capital expenditure and the reports indicate that this was well controlled. Similar good standards of control were reported for potential sources of ignition from electrical causes.

177 Dust explosions however tend to be unpredictable and it is not possible to eliminate the risk. Unless items of plant in which an explosion may occur are strong enough to contain it, or are protected by other means, e.g. by a suppression system, it is desirable that they be provided with explosion vents. The information gained during the survey indicated that only in the most modern installations did the explosion venting on the storage silos meet the standard desirable to ensure complete venting of the products of combustion. In many cases the size of the explosion vents was smaller than those which would be fitted to a new installation, but frequently it would be almost impossible to alter the plant to install larger explosion relief.

178 The standard of explosion venting in bucket elevators and dust collectors was considerably better, with satisfactory or near satisfactory venting being provided on a substantial number. While it may not be reasonably practicable to alter the explosion venting on the grain silos, the risk associated with bucket elevators and dust collectors is considerably greater and the cost substantially less. There is therefore a strong case for inspectors to press for improvements where the protection of the bucket elevators and dust collector is substantially below current standards.

179 Because the survey was concerned with the largest installation in each area it may not give a completely accurate picture but it does give an indication of the standards which can be achieved.

Meat industry

180 For several years the meat industry has had the highest incidence rate of reported accidents of any part of the food industry. Many of the processing machines used are particularly dangerous and the industry still makes extensive use of sharp hand tools. The NIG has been involved in discussions on a number of these problems with the Bacon and Meat Manufacturing Association and the Association of British Abattoir Owners.

Hand knives

181 When a knife is mechanically powered it is usual to find a high standard of guarding and other safety precautions, to prevent contact with the knife. However, accidents involving hand-held knives, particularly during boning-out operations, can cause injuries just as severe as a knife incorporated into a machine. Often the standard of precautions to prevent injury are not as high. For many years, hand knives have been the largest single cause of accidents in the meat industry, and a number of fatalities are on record.

182 It is clearly impracticable to provide machine type guards for hand-held knives, but much could be done to reduce the number of accidents. As there was a lack of information about the precautions being taken to prevent such accidents, Inspectors were asked, during 1981, to investigate one hand-knife accident report from each factory in the meat industry in their area to obtain better information on which to base a preventative programme, and to report, not only on the circumstances of that accident, but also to assess the precautions being taken in the factory to control the problem.

183 Reports were received on accidents in 254 factories. In many of these factories there were more such accidents later in the year, not included in the survey.

184 Only 6% of the accidents investigated during this exercise were due to stab wounds in the groin, but accidents due to such a knife injury tend to be severe.

Everyone using knives regularly should therefore wear a suitable apron designed to protect the lower body area. The survey revealed that in only 40% of the factories was any form of apron provided. Various types of protective aprons which resist knife penetration are available made from chain mail, aluminium discs or laminated plastics or similar materials. Regrettably it is still common for aprons to be used, which, while protecting against wet, have no resistance to the passage of a knife. 22% of the firms provided aprons of an inferior type which gave the employees a false sense of security.

185 It is essential that people employed in knife work should have adequate training in the correct techniques

for cutting operations and also in the correct care of knives. The survey indicated that the standard of training of people employed to use knives was in the whole very good and in only 11% of the cases did inspectors feel that there were inadequacies.

186 Experienced butchers however, sometimes seem to believe that experience is substitute for sensible precautions and that accidents do not happen to people who are well trained and experienced. The survey indicated that this was not so. 30% of the accidents occurred to workers with more than five years' experience in knife work, 47% to workers with between one and five years' experience in knife work and only 23% to workers with less than one year's experience.

187 Accidents also occur during boning-out when an obstruction is met and the hand holding the knife slips down from the handle onto the blade. Knives should be designed to prevent this, as far as possible, by having a hand stop at the junction of the handle and the blade. The handle must give a good comfortable grip, particularly where plastic handled knives are used. Similar considerations apply to the design of steels; it is important that there is adequate thumb guard at the junction between the handle and the surface of the steel. Despite the fact that generally the hand tools used were of good design, 14% of the accidents reported were due to injuries to the hand normally holding the knife.

188 Loose knives lying on work benches are another source of accidents, which can often be prevented by the provision of slots in the tables or suitable knife racks. Where employees are required to move around carrying one or more knives, metal sheaths should be provided, a separate one for each knife.

189 The reports suggest that about 80% of the accidents due to hand knives could have been prevented by better use of personal protective equipment. There are still some operations, particularly in slaughterhouses, where this may not be practicable, but there are many, for example, boning-out operations, where inadequate attention is being paid to this method of preventing injury. 78% of the accidents which occurred were due to injury to the non-knife hand, arm or wrist; a good standard of protection against knife cuts on the hand can be achieved by the use of chain mail or other suitable gloves. These should provide full five-finger protection. In 66% of the factories visited, no protection was provided for the non-knife hand. In one factory, it was found that by changing over from thumb and forefinger protection to full five-finger protection, the number of knife accidents was reduced by 50%. Although operators are reluctant to wear protection of this sort on the hand holding the knife, because of the reduction of sensitivity, it is usually possible to persuade them to use a protective glove and wrist guard on the non-knife hand and this should be encouraged much more widely. It is important however to recognise that protective gloves, while giving good

protection against cuts from hand knives, should not be worn by operators of power driven machinery, because of the possibility of the glove becoming entangled with moving parts of the machine.

Band saws

190 Band saws account for the highest number of machinery accidents in the meat industry; the injuries produced can be very severe. Safety cannot be achieved by guarding alone, and in order to reduce the accident toll careful attention is also required to the location of the machine, the method of operation and the training and supervision of the operator.

191 On most modern machines, the guarding fitted by the manufacturer completely encloses the top and bottom pulleys and all parts of the blade, except that part between the top guide and the processing table. There should also be an adjustable guard over the cutting part of the blade between the top guide and the table so that only the minimum amount of blade is exposed. Because of the need to ensure adequate cleaning in a machine of this type, the guards will require to be removed regularly and therefore it is essential that they are interlocked with the operation of the machine. On some smaller machines, the table is removable to assist cleaning and it also should be interlocked. Band saws very often take a long time to stop and there is a temptation not to wait before starting to clean. It is now general practice on modern machines to fit a rapid stopping device to stop the machine in approximately four seconds. This is normally achieved by a suitable braked motor but can be done by other means.

192 Most of the accidents occur when the material is being fed towards the blade. On large machines such as those used in abattoirs and large meat-cutting plants,

the movement of the meat on the feed table can be assisted by means of a series of rollers on the feed table on which the meat to be cut is manipulated. On smaller machines, sliding tables are often used to push the meat towards the blade and one manufacturer has developed portioning jigs whereby the meat to be cut is firmly held mechanically, thus removing the need for the operator's hand to be close to the blade. The development of portioning jigs has however been slow and they have not received great acceptance within the trade due to the fact that the product being processed is not of regular shape or size, requiring a variety of jigs.

193 Where the operator is working fairly close to an exposed section of blade, it is essential site the machine where he will not be distracted. The machine should where possible, be clear of gangways and doors; where necessary, a protective barrier should be erected around it. The floor surrounding the machine should be kept in good repair and the area where the operator stands should be slip-resistant. Even though slip-resistant floors are more difficult to keep clean, a small area at a machine of this type is necessary and the additional effort needed to keep it clean should be accepted as a necessary safeguard for the operator. A good standard of general and local lighting is needed and it is recommended that legible notices be posted on or near the machine stating that the machine is dangerous and should be operated only by authorised persons and that passers by should not talk to or distract the operator while the machine is in motion.

194 Training has a large part to play in ensuring the operator's safety. Such training should include information on the capacity of the machine and its limitations, on the functions of the various parts of the machine, and on the routine to be followed for cleaning and for maintenance. A Health and Safety Guidance Note *Safety of bandsaws in the food industry* HS(G) PM33 has just been published.



Fig 7 Use of a chain mail glove during a boning-out operation. The plastic apron, as seen, may not however give adequate protection against stab wounds. Work on the production of a standard test for aprons is currently being done.



Fig 8 Use of band saws in the meat industry, illustrating good factory layout. (Courtesy of Meatpak Hampshire Ltd)

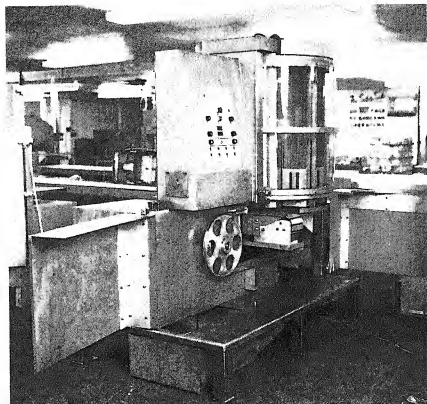


Fig 9 Automatic proportioning saw. The bottom guards when closed completely, enclose the band saw and the circular perspex guard which gives access to the rotating feed turret is interlocked. (Courtesy of Bejam Freezer Foods Ltd)

195 One development which has attracted much attention recently has been the introduction of an automatic portioning saw, which, although essentially a band saw, has several novel features which aid both productivity and safety. The machine is designed for repetitive operations and consists of a revolving turret into which the meat to be cut is placed. The vertical revolving turret presents the meat to a horizontally running band saw blade. Because of the automatic feeding arrangement, it is possible for the rotating turret and the saw blade to be completely encased in fixed and interlocked guards and this machine undoubtedly gives the operator much better protection than a conventional band saw.

196 Arguments are often put forward to suggest that safety is the enemy of productivity. The development of this automatic portioning saw shows that this need not necessarily be the case and that with careful and thoughtful design, the needs of both safety and productivity can be met satisfactorily. Indeed in this machine safety enhances production.

Bowl chopping machines

197 Bowl chopping machines can vary in size from small bench-mounted machines with bowls of about 400 mm diameter, to large free-standing machines with bowls in excess of 1200 mm in diameter. The chopping knives are usually mounted vertically at the rear of the bowl.

198 The knives are exceptionally dangerous while in motion, but are still the cause of a number of accidents even while stationary. It has been the practice to provide a solid guard for the rear of the bowl and to interlock this guard with the machine drive.

199 As it has been the practice to load and unload these machines while they are in motion, it has been considered impracticable to provide any more guarding than the cover for the rear half of the bowl. It has however been found that an open grid guard can be fitted to the right hand side of the front of the bowl, greatly reducing the chance of anyone reaching into the blades at the inrunning side of the bowl. At the outrunning side, additional guarding is normally impracticable because a powered disc for unloading the machine is often provided at this point. However a non-return flap can often be provided, so arranged as to ride on top of the material being mixed when the bowl is full, but to fall to the vertical position, thereby restricting access to the blades at the rear of the machine, when the bowl is empty.

200 Serious accidents have been caused by contact with the cutting knife when the machine is stationary and during cleaning. It is therefore essential that a temporary cover be provided which can be placed over the knife during most of the cleaning operation although obviously this cover will require to be removed when the knives themselves are being cleaned. A suitable blade guard or cover is also essential for removing or replacing the blades.

201 Consideration was given to providing an interlocked cover which covered the entire bowl even though this would have meant that it could not be unloaded while in motion. The consequence however would be more frequent approach to the stationary knives, so it is considered safest to permit unloading while in motion because this restricts the need to work close to the knives.

202 The provision of a full interlocked cover would however reduce the high noise output. A number of manufacturers of the larger models of bowl choppers do now incorporate a non-interlocked cover for the front portion of the bowl, helping to reduce both noise and contamination.

Hamburger forming machines

203 These have been used for many years and it is disturbing to note that they continue to cause serious accidents.

204 The most popular is the reciprocating plate type where the meat to be formed is in a feed tray or hopper and is pressed by cams or blades into a mould plate. This plate reciprocates and at the end of its outward travel an ejection plunger pushes the meat out.

205 Generally a good standard of guarding similar to that on a mincing machine is provided for the trapping points which exist at the cams or blades. A particularly dangerous point is present between the edge of the opening in the mould plate and the framework of the machine as the mould plate travels backwards. When

the machine is not forming properly there is a temptation for the operator to reach in. The methods by which this particular trapping point can be safeguarded are well known; it is usually necessary to have either an interlocked guard at the delivery point, or to have a delivery conveyor provided with a tunnel.

206 Several models have been supplied in recent years without this trapping point being adequately guarded and in one case there were several accidents reported within six months of it being introduced to the United Kingdom.

Machines with large hoppers

207 In recent years, it has become more common for mincers, grinders, sausage fillers and similar machines to have very large hoppers. Though in some cases these are fed by conveyor or from the floor above the machine, fed by either fixed bucket hoists or by buckets attached to forklift trucks provided with a tipping mechanism.

208 There are dangerous parts at the base of the hoppers and, because of the need to ensure a constant flow of material when the machine is part of a continuous production line, there is a reluctance to provide interlocked guards at the tops of these hoppers, so reliance is placed on providing safety by position.

209 Usually it is impossible for a person to reach over the sides sufficiently far to come in contact with any of the dangerous parts inside, but such safety can only be guaranteed so long as he is standing at floor level. With many of the machines it is very easy to climb onto part of the structure, giving very easy access to extremely dangerous parts of machinery.

210 It should be clearly recognised that when safety by position is relied upon to prevent employees from reaching dangerous parts, there is a need to ensure that this positional safety is maintained and cannot be easily overcome.

211 Such a machine needs to be cleaned regularly. There will therefore be a need for the operator or cleaner approach dangerous parts. Suitable steps or a platform are necessary. These can usually be interlocked, attached to the machine and so arranged that when they are in position for the operator to reach dangerous parts, an interlock switch cuts the power. It is essential, however, to ensure by good supervision that unauthorised methods of gaining access are not permitted.

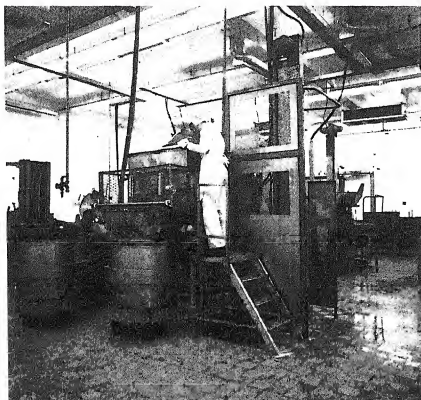


Fig 10 Large blending machine in the meat industry, showing a container used as part of a guarding system. (Courtesy of Haverhill Meat Products Ltd)



Fig 11 Details of interlocking mechanism for container used as part of a guarding system (Courtesy of Haverhill Meat Products Ltd)

Discharge into containers

212 Many large mixing, blending and grinding machines discharge the products into a container and the size of the discharge opening often allows access to dangerous parts of machinery.

213 Often, fixed guards would seriously impede the flow of the product. Similarly, a close-fitting interlocked guard would also be impracticable because the machine requires to be running to discharge the product properly. It is therefore necessary to provide an interlocked enclosure into which the container can be placed, such that the machinery is stationary when access is available.

214 An alternative is to use the container itself as part of the guarding, where the presence of the container at the discharge opening would prevent access to the dangerous parts. One method of sensing the presence of the container has been developed; the container, when pushed into position, forces back two hinged arms which operate two magnetic switches allowing the machine to run. When the container is removed the pivoting arms force the magnets away from the magnetic switches by means of strong springs.

Mincing machines

215 Mincing machines come in an enormous range of sizes. The methods of safeguarding them vary according to their size. For the large machines with large hoppers the prevention of access to the traps between the worm and the casing of the machine is normally achieved by the dangerous parts being well out of normal reach.

216 Practically all the smaller machines now have a feed opening no more than 54 mm in diameter and a feed throat at least 127 mm long, so that for most people it is impossible to force fingers down the throat to the trapping point between the worm and the casing. There have, nevertheless, still been instances where people have managed to reach the trapping point. This has occurred with children under the age of 16, who should not have been employed at this operation. People with extremely narrow hands have also been able to reach the trapping point and training is essential to ensure that operators know that the material to be minced should always be pushed towards the worm by means of a podger stick.

217 Larger machines which are also fed by hand normally have wider feed throats. These should have a restrictor plate above the feed opening to prevent access to the worm, but it is not possible to lay down standard dimensions. Therefore machines guarded in this way should be very critically examined.

218 People have also been injured at the discharge, especially when the machine is being used for coarse mincing and the openings in the plates at the discharge are large enough to admit a finger. There is a temptation to clean away material stuck to the discharge by hand and accidents have occurred when a finger has slipped in through a hole in the plate. Access should be restricted by an interlocked guard for the out-feed of the machine.

Slicing machines

Gravity-fed slicing machines

219 These are used for slicing cooked meats. They consist of a circular rotating blade and an inclined carriage which is moved backwards and forwards

manually. The meat falls down the feed chute as each slice is cut. It is important to ensure that the blade is kept sharp; with a blunt blade there is the temptation to push the last piece of the meat onto the feed plate to ensure that it is cut properly.

Horizontal carriage slicing machines

220 These machines are used for slicing uncooked meats such as bacon. They consist of a horizontal, reciprocating carriage on which the meat is gripped, and an indexing mechanism which moves it towards the blade after each slice is cut. Originally hand-operated, electrically powered versions have been available for some considerable time.

221 Some years ago a study of accidents showed that the main risk was during cleaning, particularly of the stationary blade. Recently however, two serious accidents occurred during cleaning, when the guards for the blades had been removed. The machine was started accidentally causing the reciprocating carriage to move forwards towards the exposed blade. In both cases, the hand of the employee was caught by the ham support on the carriage, and cut by the blade. As a result, a reappraisal was made of the standard of safeguarding which should be provided, agreement was reached with the major manufacturer on additional safeguards.

222 Now, a fixed guard plate is attached to the front guard for the knife which does not allow a hand to be placed on the reciprocating horizontal carriage in a position where serious injury is likely. This guard is interlocked with the machine drive and a new electronic control box has been fitted to ensure that the controls have to be operated in the correct sequence to set the machine in motion.

High-speed slicing machines

223 Bacon and meat manufacturing factories in which goods are pre-packed and in which there is a high throughput, usually use high speed slicing machines. The dangers in the use of these are very obvious and much work has been done to develop suitable guarding systems which will ensure operator safety without interfering with the essential advantage of the high speed. While they vary in detail between different manufacturers they all require an interlocked guard at the feed and a guarded conveyor at the discharge. In many cases the discharge conveyor forms part of the guarding for the blade and it is essential that the machine cannot be run unless the conveyor is in position. Because of the high speed of the blades, the run-down time is considerable and provisions for over-run of the blade must be made in the guarding arrangements.

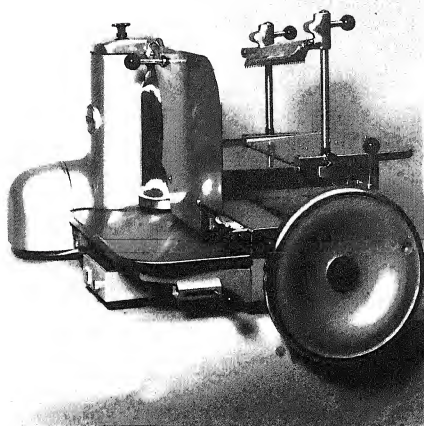


Fig 12 Horizontal carriage bacon-slicing machine with interlocked guard to protect the trap formed by the ham support on the reciprocating table and the edge of the blade guard. (Courtesy of Berkel Ltd)

De-rinding machines

224 These have been for many years a source of accidents. Conveyor-fed models have been available for flat meat for some time, but no satisfactory guarding is available for the machines used for de-rinding round meat.

225 The Health and Safety Executive recently commissioned the Polytechnic of the South Bank, Manor Road, London, to investigate the factors affecting the safety of such machines, to make recommendations for improving their safety through modifications in construction and in method of use, and to consider alternative methods of de-rinding.

226 Their report concluded that there are no commercially acceptable alternative methods of de-rinding and that the existing machine is likely to remain a feature of meat production factories.

227 They also reported that conveyor-fed machines used to de-rind flat meat are satisfactorily safe. They are available from a number of machinery suppliers and there appears to be no reason why factories should not now be doing this work on a conveyor-fed machine. If it is not possible to convert existing machines to conveyor feed, they should be phased out and conveyor fed machines introduced.

228 For de-rinding round meat the investigation was unable to suggest any form of mechanical feeding which was likely to be satisfactory. It also found that the need to manipulate the material close to the cutting

blade precluded the use of conventional forms of guarding or trip devices. The problem was then examined with a view to establishing a safer method of working at existing machines. At present the operator stands facing the toothed roller and the edge of the knife and accidents often occur when his hand slips forward on to the roller and knife. Raised feed tables help to reduce this risk by making it more likely that his hand, if it does slip, will overshoot the knife. The experimental work indicated that it was possible for the operator to stand on the other side of the machine, with shaped feed tables to assist the presentation of the round meat to the roller and knife. When this method was used, a hand that slipped was unlikely to be caught by the roller and knife.

229 However, when it was tried in production runs in two factories, there was considerable operator resistance because the operating parts of the machine were not clearly visible and additional effort was needed to manipulate the meat over the feed tables and additional guard.

230 The solution to the problem of de-rinding round meat is still some way off and further thought is needed. At present, however, the only alternative to the use of the machine is to de-rind the meat by hand and it is very doubtful whether this would produce any safety benefits; it would undoubtedly increase costs and possibly reduce the quality of the product.

Electrical stimulation of lamb and beef carcasses

231 Interest in this topic has grown quite rapidly in recent years. Rapid refrigeration of the carcasses can make the meat significantly less tender and causes an effect known as cold shortening. One method of overcoming this, while still allowing the carcass to be refrigerated rapidly, is to electrically stimulate the carcass before refrigeration.

High voltage electrical stimulation

232 Electrical stimulation using high voltages has been used quite widely in New Zealand and in the United States of America. In these countries the carcasses are stimulated while moving on a continuously running conveyor, but the technique can also be applied satisfactorily using a conveyor which moves intermittently at timed intervals; this latter system is used in the installations in the United Kingdom.

233 Where high voltages are used it is necessary to ensure that the apparatus is situated inside an enclosure. In the systems installed so far this has been large enough to accommodate two carcasses suspended on an overhead rail system with electrode pans near floor level which are raised to make contact with them.

234 The stimulation is a series of positive and negative pulses, each applied for approximately 20 seconds. Each pulse lasts for 20 ms and is fired at approximately 400 ms intervals, ie a frequency of 25 pulses per second derived from a 50 Hertz AC supply. The supply transformer is energised at 240V AC live to neutral and a maximum of 750V AC RMS can appear at the transformer secondary output so that peak voltages in excess of 1000V are possible. The total cycle time is approximately one minute then the pans return to the lower position and the conveyor re-starts.

235 The equipment should be so designed that stimulation currents cannot be applied unless (a) a carcass is present at the stimulation station (b) the emergency stop buttons are in the reset position (c) all doors to the enclosure are closed (d) the main conveyor is stationary and the motor de-energised and (e) the high voltage electric pan is in the raised position. There is a risk of a lethal electric shock to an employee from the metal pans. A high degree of electrical safety is therefore vital. Due to the size of the stimulation enclosure it is possible for someone to be inside it while stimulation is taking place, although there is no need for this; the major risk would thus appear to be to maintenance personnel. Safe procedures should be devised for maintenance work. In particular, it should

not be possible to enter the enclosure without activating an interlock device to cut off the power.

Low voltage stimulation

236 Because of the dangers associated with high voltage stimulation some work has been done to see if stimulation of the carcass can be effective at lower and safer voltages where the cost of ensuring operator safety would not be so high. Given good conditions it can be satisfactory but for it to be effective it is necessary to stimulate the carcass within five minutes or so of killing. The systems developed so far require manual operation so that the low capital cost may be offset by higher labour costs.

237 The systems operate at less than 90V peak and provided that the transformers are well designed and maintained, and a safe system of work established, there seems to be no need for an enclosure. The use of electrical stimulation is likely to increase and there are risks with both the high voltage and the low voltage methods. At present it is not clear which method will be preferred by the trade, but whichever is used careful design and planning will be needed to prevent danger.

Poultry processing industry

238 Over the past 30 years the Poultry Processing Industry has grown from virtually a cottage industry, the annual consumption of chicken in 1950 being less than 25 million birds, to its present status with a current annual consumption of 400 million birds.

239 An increasing degree of automation has accompanied the growth of the Industry. Recent years have seen the emergence of integrated synchronised systems, capable of performing the majority of processing operations automatically.

240 At a typical factory stacked crates of birds are unloaded from the delivery vehicle. Crate de-stacking, weighing, counting, and recording of birds and crates can all be done automatically. The birds are then suspended by their legs from an overhead conveyor. Having passed through a stunner, the birds are then bled by manual sticking or by a neck-slitting machine. They then travel through a scald tank, a defeatherer and a finishing tank. The stunning, killing and finishing processes completed, they pass through units which remove the head, the trachea and the feet before the evisceration processes proper begin.

provides the motive power for some of the units, as well as carrying the birds through them.

242 The evisceration processes are now increasingly performed by a sequence of Carousel units, driven from the overhead conveyor. The birds are carried around the periphery of each unit, which performs an automatic cycle of operations. The movements of the clamps and blades of the unit are controlled by rollers or cams running on metal guide channels. Carousels, which include the vent cutter/opener, the eviscerator which draws intestines and giblets, the neck cracker, and the inside/outside carcass washer, can be capable of dealing with over 5,000 birds per hour.

243 The eviscerated birds to be deep-frozen are unloaded automatically into a screw-type water bath chiller. The screw carries them through the chiller against a continuous flow of cold water.

244 When manual evisceration was used one of the major problems of the industry was the number of cuts and scratches suffered by the workers. While the wounds were rarely severe many turned septic and the nature of the process made this difficult to combat. The increased use of automatic evisceration machinery has dramatically reduced this problem, but has introduced to the industry a range of new mechanical hazards.

Evisceration machinery

241 The overhead conveyor with leg shackles is an essential part of the modern processing system. It

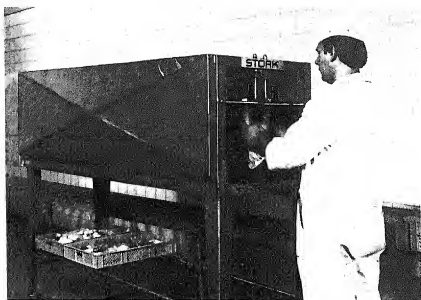


Fig 13 Chicken portioning machine where chicken is carried to the cutting knives by a conveyor chain. (Courtesy of Stork PMT)

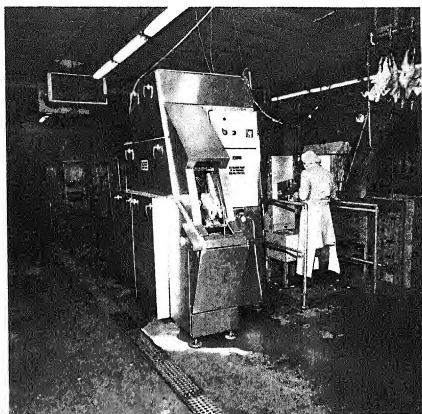


Fig 14 Prototype chicken portioning machine where chicken is carried to the cutting knives on a jig. To the right of the portioning machine is a conventional bandsaw.

245 Carousel units have not caused many accidents, but those which have been reported to the Food NIG have been serious. The greatest dangers are the accessible traps near the edges. One difficulty is that guarding needs to be assessed separately for each carousel. General requirements cannot be set down because units performing different operations present different trapping risks. Indeed, units of different manufacture performing the same operation may well have very different guarding needs. Some parts of the industry have been rather slow to safeguard these units. Some companies have provided full interlocking

enclosures around their units, but others have resisted this because of the high capital cost and of fears that it would create difficulties in production and in maintaining hygienic standards. In an effort to resolve these problems the British Poultry Federation has recently agreed to establish a working party with representatives from major users and machinery suppliers, the trade unions and HSE to consider how best these machines should be safeguarded in the future taking into account the needs of both safety production and hygiene.

Portioning

246 The catering industry, particularly the fast food restaurants, has created a demand for chicken portions and much of the portioning is carried out at the processing factory. Traditionally this has been done on a band saw with the chicken being presented manually to the blade. This method has had a poor safety record. It can also be done on smooth rotating stainless steel blades beneath which is mounted a mandrell upon which the bird is presented to the blade; this method helps by at least guiding the bird to the blade. On both these methods however some approach is necessary to the exposed blade and alternatives without such approach are clearly safer. Automatic machines are now being developed in which the bird is secured either in a jig or on chains and presented to the knife. This is more productive and safer. Recent reports indicate that some of the technical problems of earlier attempts to design automatic portioning machines have been overcome and wider use of this type of equipment can make a valuable contribution to safety in the industry.

By-products

247 In most parts of the industry the feathers and the offal are rendered to make animal feeding stuffs. The processing is often carried out in large steam heated vessels like giant pressure cookers. Several failures at the charging doors of these vessels have raised doubts about the adequacy of the design of the vessels and discussions are being held with users and manufacturers to identify modifications which can be made both to new and existing vessels. It is also important that adequate training and supervision is given to operators.

Provender milling

248 For some years now the National Joint Industrial Council for seed crushing, compounding, and

provender manufacturing industries has had a Safety, Health and Welfare Committee on which the major

employers and trade unions in the industry are represented. This committee has been particularly active in recent years in promoting good standards of health and safety within the industry.

Pelleting presses

249 One problem which received the attention of the committee was dangers in the use of pelleting presses. The number of accidents was not high, but there had been several particularly serious accidents in recent years during die setting and clearing blockages.

250 An examination of current practice showed that it was common to set the dies with the press in motion. When die-setting is done this way there is easy access to the trap between the die and the rolls. Many of the presses were fitted with interlocking on the pellet chamber door which did not prevent this practice due to the ease with which they could be overridden. On many presses the feed chute was removable and not interlocked with the machine drive, so that access was possible to the trap between the die and the rolls through the feed chute opening.

251 With the co-operation of the major suppliers of pelleting presses this problem was examined. In many cases die-setting can be done satisfactorily with the machine stationary and where this is possible the pellet chamber door should be interlocked by a positively operated interlock switch and fitted with an overrun device. Many firms have adopted this method of ensuring the safety of their personnel. Some manufacturers, however, considered that powered setting would still be essential on some presses and to overcome this problem developed special guards for the setting operation, which could be fitted into place when the pellet chamber door was open or when a removable feed chute was removed. These guards have

openings to permit access for adjustments to be made, but prevent access to the traps between the die and the rolls. They may be hinged at the opposite side of the machine from the pellet chamber door, or may be removable. They are provided with interlocking and overrun devices, so that the machine can only be run either with the pellet chamber door closed or with the setting guard in position.

252 It is encouraging to see the machine manufacturers in this industry acting positively to ensure safety for the setter as well as the operator. All too often machine designers and manufacturers neglect the special needs of the setter.

Dust

253 Provender manufacturing is a dusty industry. The dust does not usually present a hazard to health, but there is an ever present risk of dust explosions. Much has been done to provide adequate explosion protection and explosion relief on the plant used, but because of the design of the buildings in which older mills are housed, it has not always been practicable to vent the explosion reliefs to atmosphere, and the many reliefs vent inside the building. Where this is the case a high standard of cleanliness is essential to minimise the risk of secondary explosions. This requires both careful plant maintenance to prevent leaks, and also regular factory cleaning. Provender mills which are situated in the middle of towns and villages present a special risk since a secondary dust explosion could affect not only people working in the mill itself but also nearby members of the public. When new plant is being installed proper consideration should be given to the best possible location, to ensure that explosion vents do not discharge into workrooms, but into a safe place, preferably in the open air.

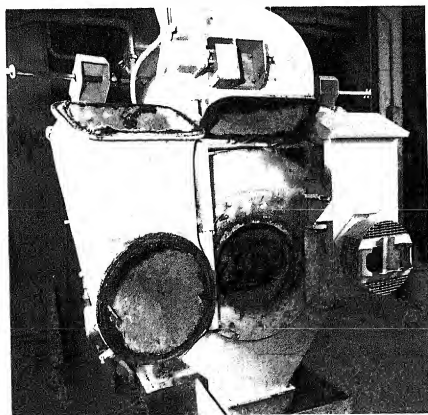


Fig 15 Pelleting press showing the normal feed to the chute at the left hand side and the press setting guard at the right hand side.



Fig 16 Pelleting press being set while in motion but with the operator protected by the setting guard

Vegetable grading and packing

254 The needs of supermarkets to have vegetables pregraded, prepacked, preweighed and presized has led to considerable change in the organisation of the vegetable packing and grading industry. Processes which previously may have been done manually, either on the farm or nearby, are now done centrally in larger and more highly automated factories.

Mechanical handling

255 There is now a decreasing use of large wooden box pallets which have to be transferred from delivery lorries to hoppers or tipper mechanisms by forklift trucks. The handling and tipping of these pallets create considerable hazards and although they are likely to remain in use in the foreseeable future they are being replaced by bulk lorries, with integral conveyors to discharge the products into a hopper. Often the guarding of the fixed conveyor system on the bulk lorry is inadequate; attention should also be paid to the electrical installation on the lorry for the conveyor. This is often powered by an electric motor plugged into a mains socket at the delivery premises, but often little thought is given to the need to provide electric motors of a suitable waterproof standard, in view of their exposure to wet and arduous conditions.

256 One striking example of such mechanisation was seen at one factory where bulk onion delivery techniques have caused problems in providing effective guarding for the traps created in their operation. The method comprises two hoppers which are large enough to allow lorries to reverse into them and discharge their contents. These massive structures are then raised and tilted to feed the contents on to a broad conveyor. A dangerous trap is created by the return of the bulk hopper to its original point and while the equivalent of fencing is provided by the close fitting buildings housing the hoppers on three sides, the open end has had to be guarded by pivoting railway crossing type gates interlocked with the tipping mechanism and incorporating a web of pivoting slats so as to be incapable of being pushed aside when down.

Packaging

257 Packaged onions and similar vegetables in supermarkets are often sold in net bags clipped and

labelled by machines which require manual presentation of each bag to the machine. This is being superseded in the larger factories by automatic machines where the operator is purely a machine minder. These are of foreign manufacture and there is a need for interlocked guards to protect the operator from the variety of dangerous trapping points present. This is an example of the technology of production outstripping the expertise in safety available in the industry concerned.

258 There have machines imported into this country whose guarding has been inadequate. Examples are cucumber shrink wrapping machines, on one of which a serious amputation accident occurred, and form/fill/seal machines being used increasingly to package celery and leeks.

259 In potato grading and packing, increasing use is being made of automatic weighing and bagging equipment. However some of the ones which have been imported have been inadequately guarded, allowing easy access to the bag-sealing mechanism. The addition of guards to an existing machine can prove difficult, illustrating the need for machine safety to be considered at the design stage.

Mechanised chilling

260 Conventionally, celery is chilled relatively slowly in a cold store, but it is understood that this can result in some loss of quality. To obtain rapid chilling one factory devised plant which involved the placing of three pallet loads of packed celery side by side on a mechanised track system into a large vacuum chamber, where rapid chilling took place. Because of the mechanised door closure and track, the only guarding which could be devised for the trapping points created was a perimeter enclosure with an interlocked counter-balanced gate for lift trucks handling the pallets.

261 These examples indicate that vegetable grading and packing has been evolving rapidly from being a simple adjunct of farming towards the technical sophistication of other parts of the food industry. It is clear from some of the problems identified by inspectors that management will have to adapt to the changes in production methods, and become more aware of the hazards which these changes can create.

Packaging machinery

Form fill seal machines

262 These are used extensively in a variety of industries. They form a tube from a roll of plastic or

similar material and fill this with the product to be packaged at predetermined intervals. They can be used either vertically for a free flowing product, or horizontally for solid materials pushed into the tube by pushers attached to a conveyor.

263 To ensure a proper standard of safety, a joint working party was formed by the Process Plant Association comprising the major manufacturers, and the working party has produced a valuable code of practice on guarding and safe operation of the machines.

264 One of the important recommendations made was that an inch or limited movement device was not considered suitable and that if one were fitted, it should not be operable when the guards for the crimp jaws were open. It is disturbing to find that on some machines a 'guard override key' was supplied which

enabled the user to run the machine with the crimp jaw guards open. Proper attention to the correct procedures for fault-finding and rectification should mean that this type of override key is unnecessary. These machines should never be run, even for fault-finding, unless the guards are in position over the crimp jaws. The guards should be designed so that the machine can be observed in operation through them. Guidance should be given to enable the diagnosis and correction of faults, which may be anticipated by observing the machine through the guard and by observing the condition of the delivered packs. The booklet *Safety in Form/Fill/Seal Machines* is available from the Process Plant Association, 25 Whitehall, London SW1.

Entry into bins and similar vessels

265 The hazards from entry into bins and similar vessels containing loose material are well known and the precautions which should be adopted are contained in HSW booklet No 47 *Safety in the Stacking of Materials*. Despite this, serious accidents still occur due to failure to observe recognised safe procedures. The following recent accidents illustrate this.

Ice hoppers

266 In an ice making factory, four ice generators discharged into a common hopper at the base of which there was a 12 in diameter screw conveyor. This carried ice to a vertical screw conveyor at one end. Over the hopper, which was 52 in high, were four steel covers with handles; these were not fixed in place. The plant operated automatically with the screw conveyor programmed to start revolving 5 seconds before any ice discharged from the generators. The automatic system was so arranged that if there was any malfunction, including jamming of the screw conveyor, the entire plant would trip out until an operator rectified the fault and reset the plant. If the plant was switched or tripped off the plant conveyor systems could be set in motion to assist in clearing blockages by a switch at the main control panel.

267 One day, ice 'bridged' in the hopper and the plant stopped automatically. The ice plant manager removed the cover from the hopper and switched on the conveyor system. He broke the bridge with an implement and the horizontal conveyor cleared ice from the hopper. He then saw his pocket calculator lying in the hopper. He switched off the conveyor system and climbed in to retrieve it, but as he was doing so both screw conveyors started up and his feet

were dragged by the horizontal screw towards the vertical screw conveyor. He managed to operate the horizontal screw isolator switch beside the hopper, but the vertical screw continued to run and amputated both his lower legs.

268 Possibly because of a fault in the automatic control system for the plant the screw conveyor operated unexpectedly, but this accident could have been avoided by the very simple expedient of operating the plant isolator switch before entry into the hopper. Automatic control systems should not be fully relied upon for safety. There is no substitute for proper isolation of the electrical supply where there is a foreseeable mechanical danger.

269 In another ice-making factory there was a similar hopper for ice but in this instance the ice was discharged through the bottom by a manually-operated slide valve on to a conveyor. If the ice in this hopper bridged, there was a temporary stop in the supply of ice. It was normal then for an employee to go into the hopper and by standing on top of the ice use a pole or rake to push further ice towards the slide valve.

270 On one occasion, after approximately 1.5 tonnes of ice had been discharged in this way, the ice flow from the slide valve stopped and the injured person went to the hopper with a pole. He fell into the hopper and ice which had piled up around the sides cascaded onto him, almost burying him. He was located when a colleague poked a rod through the slide valve to try and dislodge some ice and struck his boot; the police, fire brigade and ambulance were called to release him. In this case the injured person was freed very quickly and was back at work the next day, but the consequences could have been much more worse, illustrating the need for a proper system of work when entry into such a hopper is necessary.

Soya hopper

271 In a provender mill soya meal had become compacted in the bottom of a feed bin and two employees of an outside contractor were given the job of entering the feed bin to free the compacted soya.

272 The occupiers of the factory supplied the contractor's employees with a safety harness to be worn by one of the employees while the other remained outside, holding the end of the rope. Checks were made during the morning to see that this was being done. Work inside the bin proceeded very slowly because of the condition of the soya, which was proving very difficult to move and during the lunch break the two employees discussed the progress of their work with their employer. He agreed to help them and after lunch entered the bin with one of his employees. The employer did not put on a safety harness. As they freed the compacted soya another person operated the slides of the bin outlets to allow the freed soya to flow out of the bin.

273 After about 30 minutes work the employer thought he had removed enough soya from the sloping bottom of the bin to prevent any danger of falls and he

called the third man, who was outside the bin, to come down. He removed his safety harness and all three began work upon the soya; when it was flowing more freely the employer left to look at another job.

Shortly after he left one of the employees was caught in the flow of soya and despite the efforts of his colleague to extract him, he was slowly dragged beneath the soya. It took some time to find him again and by the time he was released he was dead.

274 The behaviour of compacted materials of this sort is quite unpredictable and the occupiers of the factory clearly recognised this fact in providing both instructions and equipment to enable the contractor's employees to work in safety. There is at least a good chance that the serious consequences of this accident could have been avoided if the occupier's advice had been followed and his equipment properly used.

275 Clearly, however, if the material was prevented from compacting in the bin it would not be necessary for employees to enter the bin at all. Therefore the real problem to which firms should be directing their attention is the prevention of blockages.

Use of clear plastics as a guard material

276 One of the disadvantages in the provision of guards is the fact that they can restrict vision and create difficulties for the operator. This can often be overcome by transparent material; the use of high impact resistant plastic sheeting as a guard material has been increasing in the food and packaging industries in recent years.

277 These materials are, however, only really suitable if the sheets retain their clarity; some plastics quickly lose their transparency and become covered with surface cracks. Some are attached by the cleaning agents used for cleaning and sterilising the machines. It is obvious, therefore, that the choice of plastic material for guard construction is critical. Cracking often occurred at the points where the material was fixed to a metal framework, due to inadequate allowance being made for the different coefficients of expansion of the plastic and the metal.

278 One company in the food industry undertook a considerable amount of development work to try to arrive at a suitable design of guard, using plastic sheet. The essential requirements of the materials to be used were that they should have good clarity, be resistant to the chemicals used in the cleaning processes, be suitable for contact with food and have high impact resistance. It was found that the transparent plastic sheeting which

was available at the time had all the necessary qualities other than impact resistance, but that by increasing the thickness of the sheeting to 13 mm there was sufficient strength without affecting the other qualities.

279 One advantage when using the thicker material was that it was strong enough not to require attachment to metal framing. This reduced the likelihood of cracking, and as fewer joints were necessary, traps were not created where bacteria could multiply.

280 A prototype guard using this material was made for a can filler and sealer and has now been in satisfactory service for several years. The material has now been used successfully on a wide range of machines. It is now supplied by several specialised fabricators around the country. As well as being used for complete machine enclosure, unframed transparent plastic sheeting has also been used for a number of smaller guarding applications.

281 Complete enclosure by such a guard offers considerable advantages. Because the machine is completely enclosed with fixed and interlocked panels no access is possible unless the machine is at rest. It is often possible, therefore, to dispense with individual drives and the clear vision afforded to the operator and the maintenance engineer makes fault-finding and maintenance very much easier and safer.

282 Although the development work on this particular guarding system was done using 13 mm sheeting, it is not now the only plastic substitute for

solid or perforated sheet metal. A paper describing the development of this guarding system was published in the August 1980 issue of *Health and Safety at Work*.

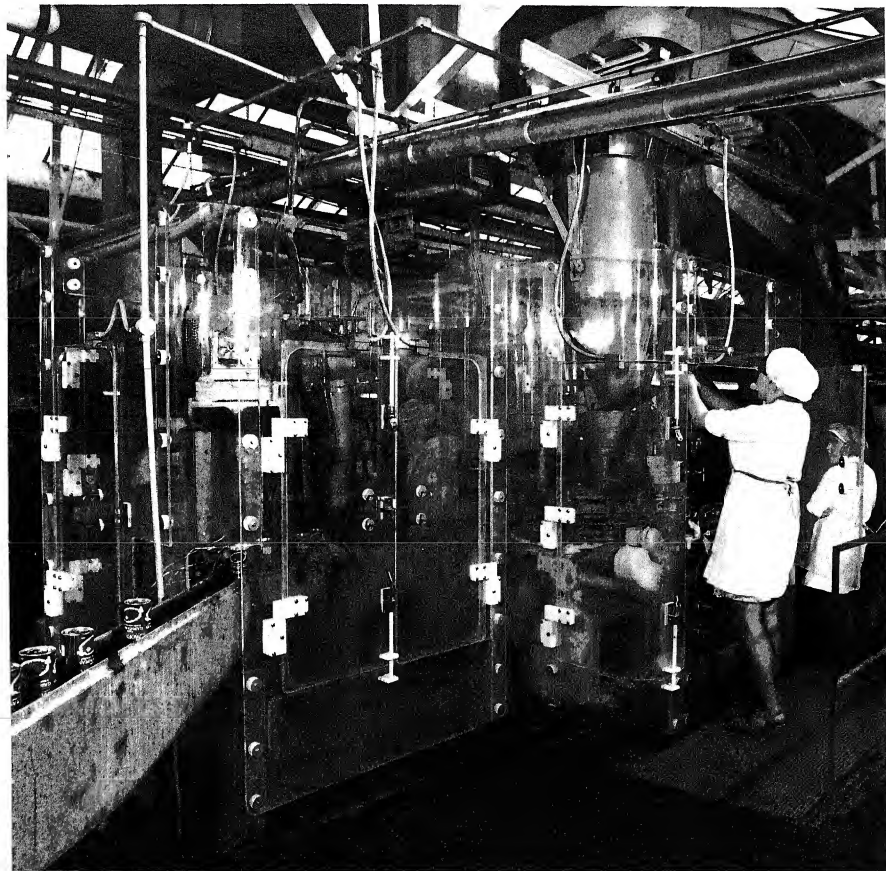


Fig 17 Complete machine enclosed by fixed and interlocking transparent plastic panels. The large interlocking doors give easy and

safe access for both production and maintenance. (Courtesy of Beecham Foods Ltd and ICI Ltd)

New machinery

283 Many manufacturers and suppliers of new machinery for use in the Food & Packaging Industry make considerable efforts to ensure that this machinery will be safe and without risks to health, but some have given little thought to the subject.

284 Most British manufacturers and most of the larger suppliers of imported machinery are fully aware

of the duties placed on them by Section 6 of the Health & Safety at Work Act; however many smaller importers appear to have only a very hazy idea of their responsibilities and even less knowledge of the necessary standards of safety. To make more information and advice available to them, a pamphlet has been issued by HSE on *Obligations on importers of machinery, plant and substances into Great Britain*.

285 Probably because of the present recession, manufacturers of process machinery are finding that business is more difficult to obtain. Several complaints of unfair competition have been dealt with by the NIG, alleging that other manufacturers and suppliers of similar machines were not providing the same degree of safety. Considerable efforts are made to liaise with manufacturers and suppliers, but it is inevitable that in a developing field like safety, not every manufacturer will be at exactly the same stage of development at the same time. The work of ensuring broad uniformity of safety standards is therefore a continuing task for inspectors.

286 It is not uncommon to find suppliers who act purely as sales agents and to not have the necessary design and engineering expertise to give proper advice to the customer. In one instance the importer of one machine was found to be in business mainly as a travel agent who handled one or two machines a year and who obviously had no appreciation of the duties placed on him by law, the dangers of the machine or the necessary guarding standard.

287 Attempts to solve the guarding problems of imported machines have taken a lot of inspectors' time, mainly because safety was not considered in the design of the machine. Guarding provided as an afterthought, to deal with an inherently poor design, is always unsatisfactory. Even when action is taken against the supplier of unsafe machinery, better manufacturers and suppliers often feel aggrieved since a potential sale has been lost to them.

288 There is a large number of small importers and suppliers, and a limit to the amount of time that inspectors can devote to this work; users of plant and machinery could assist by making closer enquiries about safety aspects of the machinery before an order is placed.

Trade exhibitions

289 One way in which the NIG has tried to deal with this problem has been by attending the trade exhibitions which are held for the display and sale of new machinery and plant. Visits to these Exhibitions help the NIG keep up to date with developments in equipment.

290 It is often possible at a trade exhibition to identify new suppliers and manufacturers and to

identify new machinery which would have safety problems if sold for use at work in the condition in which it is exhibited. While the firm's representatives on the stand may not be able to discuss these problems in detail, the NIG can arrange for suitable follow-up visits to be paid to the firm's head office.

291 Some firms at these Exhibitions take considerable care to ensure that the machines on display are adequately safeguarded and that they have taken due note of their duties to protect members of the public visiting the Exhibition; however there have been notable instances where firms wished to demonstrate their machines without guards in position, to enable potential customers to view the operating mechanism more easily. It was not uncommon to find interlock switches being overridden so that potential customers could see machinery more clearly. Where it is considered necessary to provide good vision of the operating parts of a machine, there is no reason why more extensive use could not be made of sheet plastic materials so that adequate protection can be given to the over-inquisitive visitor while still providing an adequate view of the machinery on display.

292 The NIG has visited the Meat Trades Fair at Harrogate, the Bakex Exhibition at Harrogate, the Packaging Index Exhibition at Wembley, the Hotelympia Exhibition at Olympia, the Foodpack Exhibition at Olympia and the Catering Equipment Exhibition at Birmingham.

293 At the Food Pack Exhibition at Olympia the NIG occupied a stand on behalf of the HSE. On display were examples of machines to illustrate the appropriate principles of safeguarding. Photographic display stands were also used and a wide range of health and safety literature was on sale. These stands attracted a considerable amount of interest and an Inspector from the NIG was available for part of the time to deal with visitors' queries.

294 At the Packex and Brewex Exhibitions in the National Exhibition Centre in Birmingham in 1980 the Food and Packaging NIG co-operated with the Brewing and Distilling NIG in occupying a stand on behalf of the HSE. This stand also featured examples of well-guarded machines from the packaging and brewing fields, as well as static displays and literature sales.

295 The involvement of the NIG at trade exhibitions is therefore seen as a continuing part of the effort to ensure that suppliers fully appreciate the extent of the responsibilities placed on them by law.

Some unusual problems

296 The growth of restaurants with more exotic menus has brought with it the establishment of small businesses designed to produce specialised foods. The following examples illustrate the range of unusual problems encountered.

Bean shoots

297 In one area are several businesses growing bean shoots for the Chinese market. To aid germination, a high temperature is necessary and in one basement visited, it was found that the temperature was 90°F with 100% humidity. These conditions were being created by a number of gas heaters, most of which were un-flued and vented directly into the workroom. Sampling with Draeger detector tubes revealed significant quantities of both carbon monoxide and carbon dioxide and the assistance of the local Gas Board was obtained to provide adequate advice to the occupiers on the conditions necessary for ensuring proper combustion of the fuel. Immediate action was taken by the occupier to provide flues for the heaters and to install suitable controls to ensure that the correct environment could be maintained.

298 In another set of premises undertaking a similar process, liquefied petroleum gas was the fuel used to maintain the high temperatures. The occupier had 35 large LPG cylinders in use, together with a similar number of spares and empties, which were stored in the basement of the building. An Improvement Notice resulted in a proper store for liquefied petroleum gas cylinders being built.

Bean curd

299 One manufacturer of bean curd imported a machine direct from Hong Kong. It had a 4-ft diameter

basket rotating at over 300 rpm and was completely unguarded. A Prohibition Notice was served and eventually a guard was provided. At subsequent visits however, it was found that the guard and its interlocking arrangements had been removed and the occupier was prosecuted and fined £250.

Noodles

300 A factory making noodle nests had two machines imported direct from Italy. The laminated dough was fed on a tray through adjustable rollers which were not guarded but could be separated by the pressure of a finger. The pasta then passed through a set of grooved rollers resembling two circular combs. These shredded the pasta to the required thickness. It was then cut to length by a rotary knife as it met a stationary knife at the back of the machine. The length of the pasta could be varied by altering the gearing of the machine.

301 The knife was protected by a hinged plate at the front of the machine but blockages were not unusual. An accident occurred when an employee was attempting to clear such a blockage at the knife without first switching off the machine.

302 It is well established that when access is needed frequently, either for cleaning or for operation, or for clearing blockages, the only satisfactory way of safeguarding the dangerous parts is to provide an interlocked guard. Following this accident, the factory fitted interlock switches to the guards; at their first attempt they fitted them incorrectly (they failed to danger) so advice had to be given to ensure that they were replaced by ones which failed to safety. Advice on the fitting of limit switches used for interlocking purposes is available from the Health and Safety Executive.

Pattern of inspection

303 The work of inspectors involved with the food industry consists of a mixture of basic inspections and reactive visits.

304 A basic inspection of a factory may only occupy half a day and can only be regarded as a spot check on conditions at that particular time. However inspectors also enquire into problems which could occur at other times; the necessary knowledge to enable them to make the correct enquiries can often be gained at reactive visits, where they may be investigating accidents or dealing with complaints or making special enquiries as a result of initiatives made by headquarters of the NIG. The staff resources available to a Principal Inspector are often inadequate to enable him to devote more time to probing, in depth, into the whole organisation of

safety in a factory, unless there is something noted during the course of basic inspection which indicates that more extensive enquiries are necessary.

305 To gain more knowledge about possible problems a special exercise was carried out in one area, to inspect, in depth, a new food factory which had recently been opened by one of the major food groups. Such inspection, however, can only be done infrequently because of the staff resources required and because of staff time demanded from the operating company in arranging for the inspections to be carried out. This exercise was therefore carried out with the full agreement of the operating company, to establish where deficiencies might arise and what action could be

necessary, not only in this factory, but also throughout the industry.

306 The inspection involved general inspectors from the Food Group and inspectors from the Field Consultant Group (FCG) dealing with problems of mechanical engineering, dust and gas explosions, noise and electricity.

307 All aspects of the firm's operations were examined: production, maintenance, cleaning, distribution, the work procedures and training evolved to cope with hazards, physical safeguards and the safety of the buildings and their access.

308 This exercise highlighted problems which might not have been detected in a basic inspection, or before an accident had occurred. Examples regarding the electrical installation and the electrical maintenance procedures were

- (a) isolation by use of interlocks rather than the isolator switches;
- (b) isolators, panels and distribution boxes not clearly labelled to ensure proper isolation;
- (c) no locking-off facilities at isolators;
- (d) lack of clear policy to 'make dead' before working on electrical equipment and a tendency for electricians to do more 'live' work than was necessary;
- (e) failure to place overload, tripping and re-setting devices where they were easily accessible, particularly when ready access may be needed;
- (f) lack of insulation of electrical terminals inside machine enclosures where jobs may need to be done high above the ground;
- (g) safety interlocking circuit routed through solid state control equipment where component failure could cause the equipment to fail to danger.

309 Although the machinery and plant had been made safe for the production operators little thought had been given to the problems faced by the hygiene staff. On very large pieces of equipment they may have to enter the machine or enclosure to carry out their task and may not be visible to other people working in the factory. Jobs of this sort require good safety training and possibly formalised permit to work systems. This is even more important when a partly-cleaned machine has to be moved under power to expose other parts for cleaning.

310 Enough thought had not been given to means of access for routine maintenance jobs at high level. Similar safe access was also required for work done by maintenance staff where space was restricted and access difficult.

311 The exercise also improved understanding of the safety needs of the employees, and also helped more senior managers appreciate the safety problems faced by their colleagues.

312 Good standards of maintenance and hygiene are essential for any firm in the food industry and the information gained in the exercise suggested improvements in the way these tasks were carried out. More thought needs to be given to devising methods of automatic or semi-automatic cleaning, brushing and scraping and more use could be made of automatic lubrication systems.

313 Reference has been made to solid-state control equipment; advice on the safety implications is given in the HSE booklet OP2 *Microprocessors in industry*, obtainable from HMSO, ISBN 0 11 883429 0.

Joint consultation

314 Although an Industry Advisory Committee has not been created for the Food & Packaging Industries the NIG has been actively involved in joint consultation with a large number of trade associations and trade unions who have an interest.

315 There are well over two hundred trade associations representing various parts of the food industry and the NIG has only been able to maintain regular contact with some of the larger ones.

These include:

Association of British Abattoir Owners
 Association of Butter & Cheese Packers
 Association of Cheese Processors
 Bacon & Meat Manufacturers Association
 British Poultry Federation
 Cake & Biscuit Alliance

Catering Equipment Distributors Association
 Catering Equipment Manufacturers Association
 Dairy Trade Federation
 Federation of Bakers
 Food Manufacturers Federation
 Fruit & Vegetable Canners Association
 National Association of Master Bakers, Caterers & Confectioners
 NJIC for Flour Milling Industry
 NJIC for Seed Crushing, Compounding and Provender
 Manufacturing Industries
 Process Plant Association

and trade unions involved with various working parties and committees include:

Amalgamated Union of Engineering Workers
 Bakers Food & Allied Workers Union
 General & Municipal Workers Union
 Transport & General Workers Union
 Union of Shop Distributive & Allied Workers

316 The NIG would like to thank all these organisations for their willing cooperation, and for the constructive way in which they have discussed and helped to resolve some of the health and safety

problems in their industries.

317 It is hoped that this cooperation will continue, enabling further progress to be made in the future.

Postscript

The Food NIG was located at the Area Office, Chelmsford, during the years 1977-82. On 1 January 1983, the NIG was relocated at the Scotland West Area Office, Glasgow. The move was one of a number of changes made for organisational reasons. Despite the change of location and change of staff, the work of the Food National Industry Group will continue as before.

Appendix Statistical Tables

Introductory note

All tables of accidents except tables 1b, 5 and 6 are based on figures collected under the accident reporting requirements of the Factories Act 1961.

Tables 1b, 5 and 6 are based on reports made under the Notification of Accidents and Dangerous Occurrences Regulations 1980 which came into effect on 1st January 1981. They are not strictly comparable with the earlier years because the new Regulations extended the

coverage to all employees (eg office staff in factories) and also removed the known element of under-reporting.

A new analysis of accidents by site and injury has been included for 1982 only.

In Table 1b the figures for injuries in 1981 are revised (and differ slightly from those shown in Manufacturing and Services Report 1981) but the incidence rates are based on the earlier provisional figures.

Table 1a Accidents reported to HM Factory Inspectorate ^a: Detailed industrial analysis 1975-80

SIC Order and Minimum List Heading	Standard Industrial Classification	Fatal accidents			All reported accidents			All reported accidents: incidence rates ^b per 100 000 at risk			
		1978	1979	1980	1978	1979	1980	1975-77 (average)	1978	1978 ^{p,R}	1980 ^p
Order III	Food industry										
211	Grain milling	2	2	2	919	855	715	5870	6230	5890	4850
212	Bread and flour confectionery	2	1	—	2999	2730	3640	3640	3760	3680	3270
213	Biscuits	1	—	2	1371	1257	1099	3680	4100	3360	3160
214	Bacon curing, meat and fish products	1	5	—	6229	5855	5094	6720	7400	6820	6010
215	Milk and milk products	2	—	1	1715	1701	1653	3150	4050	4270	4110
216	Sugar	—	—	—	534	429	352	4550	5500	4260	3360
217	Cocoa, chocolate and sugar confectionery	—	—	2	2279	2209	1804	3830	3860	3750	3330
218	Fruit and vegetable products	1	—	1	2413	2289	1883	4920	5250	5030	4300
219	Animal and poultry foods	3	2	3	467	460	392	2760	2910	2760	2440
221	Vegetable and animal oils and fats	—	—	—	165	170	135	2660	2910	2680	2410
229	Food industries not elsewhere specified	—	1	—	1125	1136	971	4610	4230	4410	4140
Totals		12	11	11	20216	19091	16465				

^a Includes accidents reported under Offices Shops & Railway Premises Act 1963 and Health and Safety at Work etc Act 1974.

^b Factories Act only.

^p Provisional figures.

^R Revised figures.

^e Reportable under NADO Regulations.

Note The footnotes apply to both Table 1a and Table 1b.

Table 1b Accidents reported to Health and Safety Executive *: 1981-82

SIC Minimum List Heading		Injuries 1981 ^R			Injuries 1982 ^P			Incidence rates per 100000 employees			
		Fatal	Major	Total	Fatal	Major	Total	1981 ^R	1982 ^P	Fatal and major injuries	All re-reported injuries
211	Grain milling	1	17	665	2	17	622	97.8	3530	100.5	3917
212	Bread and Flour confectionery	2	65	3161	0	65	2834	69.6	3520	78.5	3427
213	Biscuits	0	12	1263	1	21	1224	30.3	3020	54.7	3188
214	Bacon curing, meat and fish products	1	94	6153	3	99	5625	91.6	5490	105.7	6010
215	Milk and milk products	1	73	2485	1	61	2403	150.7	4620	131.1	4954
216	Sugar	0	9	349	1	12	294	101.0	3440	134.8	3303
217	Cocoa, chocolate and sugar confectionery	0	29	1644	0	26	1463	44.2	2460	45.2	2548
218	Fruit and vegetable products	1	36	1943	0	39	1663	64.3	3650	74.7	3185
219	Animal and poultry foods	0	30	717	3	36	645	121.2	2980	153.8	2756
221	Vegetable and animal oils and fats	0	11	372	0	8	316	145.2	5400	133.3	5266
229	Food industries not elsewhere specified	1	36	1124	0	32	988	103.9	3330	83.5	2605
Total		7	412	19876	11	416	18077				

Table 1b covers accidents to employed persons only, in premises where HM Factory Inspectorate is the Enforcing Authority.

Figures for major injuries include fatalities.

Table 2 Accidents by nature and agency 1978*

Agency	Falls to persons to lower level of 6ft 6in or less	Striking against object or material	Exposure to or contact with extremes of temperature or environmental conditions	Accident type not elsewhere classified	Falls to persons to lower level of over 6ft 6in	Caught in, under or between objects or materials	Exposure to or contact with electric current	Accident type not classified for lack of data	Fall, trip or slip of person on same level	Rubbed or abraded by object or material	Exposure to or contact with potentially harmful substance	Struck by object or material	Over exertion strenuous or awkward movements and free bodily motion	Powered vehicle accidents	Total
Prime movers and transmission m c	1	—	—	3	2	12	4	4	—	—	—	—	—	—	26
Lifting and conveying m c and plant	12	—	13	87	95	220	9	35	—	—	—	—	—	—	473
Process machinery	16	1	27	286	395	674	107	121	40	6	5	1	9	5	1691
Transport mainly for goods	168	16	121	425	233	287	27	192	2	1	—	179	3	—	1665
Transport mainly for persons	14	—	4	8	11	4	1	—	—	—	—	3	—	—	50
Other machinery plant and equipment	60	8	171	918	432	187	703	348	97	26	13	1	29	3	2996
Containers	68	6	260	803	352	236	139	1671	59	1	8	4	8	—	3622
Buildings, structures, working surfaces	940	94	2162	121	258	93	20	97	21	—	—	9	9	1	3825
Excavations, trenches, tunnels	23	1	23	3	5	1	6	12	1	—	—	—	—	—	58
Working environment	19	1	351	9	9	5	—	1	198	2	3	3	2	—	620
Injuries resulting from explosions and fires	8	—	1	1	1	—	—	—	5	—	—	1	—	—	11
Chemicals, chemical compounds	1	—	110	8	2	—	24	—	52	—	113	—	3	—	320
Materials, Articles NEC	57	8	438	859	538	169	398	755	113	1	10	7	40	5	3398
Clothing, animals, persons	36	4	97	129	83	61	27	114	19	—	1	5	15	1	592
Other agencies	17	1	65	29	35	15	26	144	5	—	1	3	19	59	419
No agency	5	—	31	24	27	4	10	106	5	—	3	2	3	6	226
Other (invalid)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total (all agencies)	1445	140	3874	3713	2478	1968	1501	3605	618	37	159	217	148	89	19992

a Factories Act only.

NEC Not elsewhere classified

Table 3 Accidents by nature and agency 1979^a

Agency	Falls to persons to lower level of 6ft 6in or less	Striking against object or material	Exposure to or contact with extremes of temperature or environmental conditions	Accident type not elsewhere classified	Falls to persons to lower level of over 6ft 6in	Caught in, under or between objects or materials	Exposure to or contact with electric current	Accident type not classified for lack of data	Fall, trip or slip of person on same level	Rubbed or abraded by object or material	Exposure to or contact with potentially harmful substance	Struck by object or material	Over exertion strenuous or awkward movements and free bodily motion	Powered vehicle accidents	Total
Prime movers and transmission m/c	1	—	3	5	3	15	1	3	—	—	—	1	—	—	32
Lifting and conveying m/c and plant	—	—	19	68	76	204	12	33	3	—	—	—	2	1	425
Process machinery	12	1	47	313	327	653	103	98	22	8	6	8	7	7	1605
Transport mainly for goods	158	13	85	387	171	250	17	185	4	—	4	156	8	3	1441
Transport mainly for persons	11	—	7	7	3	5	—	—	1	—	2	10	2	1	56
Other machinery plant and equipment	57	4	160	1245	265	144	334	272	82	27	13	2	18	3	2626
Containers	63	10	271	796	291	251	78	1553	45	7	8	7	2	2	3383
Buildings, structures, working surfaces	808	102	2098	128	221	109	3	94	17	—	—	9	7	2	3598
Excavations, trenches, tunnels	43	2	15	4	3	1	1	3	2	—	—	1	—	—	75
Working environment	16	2	533	20	20	5	2	9	200	—	1	3	3	—	814
Injuries resulting from explosions and fires	—	—	—	—	—	—	—	—	—	—	2	—	—	—	9
Chemicals, chemical compounds	5	1	104	5	9	—	33	1	39	—	113	—	5	—	311
Materials, Articles NEC	53	4	493	1044	561	189	288	762	135	2	14	8	33	6	3592
Clothing, animals, persons	23	—	59	108	80	33	10	141	19	1	5	4	17	1	501
Other agencies	23	2	48	13	27	8	13	152	4	1	1	2	21	73	385
No agency	—	—	12	2	1	1	2	52	—	—	—	—	5	—	76
Other (invalid)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total (all agencies)	1279	141	3951	4145	2058	1868	897	3365	575	40	170	203	138	99	18929

Table 4 Accidents by nature and agency 1980^a

Agency	Falls to persons to lower level of 6ft 6in or less	Striking against object or material	Exposure to or contact with extremes of temperature or environmental conditions	Accident type not elsewhere classified	Falls to persons to lower level of over 6ft 6in	Caught in, under or between objects or materials	Exposure to or contact with electric current	Accident type not classified for lack of data	Fall, trip or slip of person on same level	Rubbed or abraded by object or material	Exposure to or contact with potentially harmful substance	Struck by object or material	Over exertion strenuous or awkward movements and free bodily motion	Powered vehicle accidents	Total
Prime movers and transmission m/c	—	—	—	2	12	29	1	4	—	—	—	—	1	—	49
Lifting and conveying m/c and plant	7	2	14	47	55	40	5	11	1	—	—	—	—	—	283
Process machinery	11	2	16	257	270	552	18	73	16	4	2	1	9	10	1241
Transport mainly for goods	144	13	93	306	135	280	4	136	3	—	1	64	14	5	1196
Transport mainly for persons	8	—	5	11	9	11	—	2	—	—	—	6	2	1	55
Other machinery plant and equipment	54	5	194	1485	371	185	99	460	96	14	26	—	13	2	3004
Containers	44	8	218	733	253	225	39	1497	50	2	6	1	7	2	3085
Buildings, structures, working surfaces	651	82	1780	112	156	92	5	81	13	—	3	2	14	—	2991
Excavations, trenches, tunnels	23	1	25	5	5	2	—	4	3	—	—	1	—	—	71
Working environment	25	10	319	25	13	2	7	7	155	1	6	1	1	2	574
Injuries resulting from explosions and fires	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chemicals, chemical compounds	3	1	117	16	2	2	14	4	31	1	110	—	3	1	301
Materials, Articles NEC	32	5	331	925	387	115	96	585	83	1	5	2	18	3	2588
Clothing, animals, persons	7	—	17	121	20	44	4	11	11	—	1	—	20	—	256
Other agencies	13	2	36	29	73	17	5	125	7	4	1	3	11	84	410
No agency	—	1	41	12	14	6	4	133	1	—	—	1	4	1	218
Other (invalid)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total (all agencies)	1022	132	3206	4086	1773	1700	301	3133	470	28	161	82	119	109	16322

^a Factories Act only.

Table 5 Accidents by nature and agency 1982

Type	Machinery except ind/site vehicles etc and trailers	Road transport	Working surfaces	Gases/vapours/fumes	Live animals	Ind/site vehicles	Rail transport	Scaffold/salework	Other/unknown	Trailers	Air/water transport	Excavations	Hand tools	Other plant/equipment	Fires/explosions	Total
Over exertion	66	98	10	87	61	0	0	1874	192	3	9	0	0	11	1285	3696
Asphyxiation	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
Caught/trap-collapse	3	1	0	0	0	0	0	11	1	0	0	0	0	0	1	17
Caught/trapped	734	191	4	25	40	0	0	625	114	1	2	0	0	3	124	1836
Electric current	0	2	0	0	1	0	0	9	0	0	0	0	0	0	6	18
Fall etc-lower	25	31	6	0	146	0	0	72	828	11	20	0	0	0	1	52
Fall etc-same/higher	35	52	2	8	62	0	0	342	2323	3	41	0	0	3	737	3608
Harmful substances	0	0	0	0	0	0	0	7	0	0	0	1	26	0	126	160
Other	25	11	0	15	8	0	0	48	6	0	1	2	3	5	626	750
Powered vehicles	0	19	0	0	25	0	0	1	3	0	2	0	0	0	0	50
Striking/stepping	382	76	1	210	42	0	0	836	212	7	7	0	0	2	474	2249
Struck by object/material	165	235	5	1360	45	0	0	1303	70	4	0	8	0	24	801	4020
Extreme temperature/ environment	12	1	0	2	2	0	0	68	0	0	0	17	4	0	378	484
Total	1447	717	28	1707	432	0	0	5196	3749	29	82	28	34	49	4611	18109

Table 6 Injuries by site and nature 1982

Site	Amputation	Concussion and internal injuries	Burns	Poisonings and gassings	Injuries NEC	Loss of sight or eye	Laceration and open wounds	Sprains and strains	Injuries unknown	Fracture	Contusions and crushings	Superficial injuries	Dislocation	Multiple injuries	Total
Eye	0	0	1	0	0	23	32	42	1	0	158	0	7	39	303
Ear	0	0	0	0	1	2	1	0	0	0	3	0	0	0	7
Other parts of the face	0	0	21	0	1	38	33	30	2	0	45	1	0	14	185
Head (excluding face)	0	0	15	0	64	95	112	3	0	4	66	1	7	66	433
Several locations of head	0	0	0	0	2	5	8	2	0	4	4	1	1	3	30
Neck	0	0	4	0	1	0	10	10	0	132	3	0	2	34	196
Back	0	0	33	8	50	2	270	4	1	2639	28	1	10	381	3427
Trunk	0	0	130	1	70	19	246	24	4	226	15	1	6	124	866
Several locations of neck, back and trunk	0	0	1	0	0	0	5	0	0	9	1	1	0	0	29
One finger/thumb	140	0	279	18	2	1095	314	26	7	62	996	6	18	228	3191
Two or more fingers/thumbs	17	0	28	0	0	131	71	23	0	7	100	4	5	28	414
Hand	3	0	108	2	2	459	290	127	8	61	389	5	17	190	1661
Wrist	0	0	288	6	1	90	91	19	0	276	54	0	3	119	947
Rest of upper limb	0	0	220	27	4	111	365	112	1	454	103	2	8	269	1676
Several locations of upper limb	2	0	5	0	0	11	16	12	0	8	4	1	0	15	74
One toe	0	0	17	0	0	3	22	0	0	0	3	0	0	1	46
Two or more toes	0	0	141	0	5	37	361	133	0	90	87	2	8	155	1019
Foot	0	0	85	1	2	14	132	13	0	627	32	1	0	94	1001
Ankle	0	0	101	13	8	93	510	47	1	346	134	5	9	304	1571
Rest of lower limb	0	0	1	0	0	2	21	9	0	6	4	2	0	11	56
Several locations of lower limb	0	0	16	0	3	10	118	83	0	40	39	58	7	86	460
General locations	0	0	0	0	2	0	2	0	23	0	0	0	22	4	53
Unspecified locations	0	0	2	0	0	3	2	4	5	19	0	1	6	48	90
Total	163	0	1655	76	220	2256	3152	724	53	5010	2292	94	137	2277	18109

Table 7 Transport accidents by type of vehicle and type of accident 1978-80^a

Vehicle in motion	Year	Falls to persons to lower level of 6ft 6in or less	Striking against object or material	Exposure to or contact with extremes of temperature or environmental conditions	Accident type not elsewhere classified	Falls to persons to lower level of over 6ft 6in	Caught in, under or between objects or materials	Exposure to or contact with electric current	Accident type not classified for lack of data	Fall, trip or slip of person on same level	Rubbed or abraded by object or material	Exposure to or contact with potentially harmful substance	Struck by object or material	Over exertion strenuous or awkward movements and free bodily motion	Powered vehicle accidents	Total
Fork lift truck	1978	8	1	5	132	35	86	6	4	—	—	1	112	2	—	392
	1979	10	1	—	123	21	59	4	9	—	—	1	85	1	3	317
	1980	3	1	3	118	24	102	—	9	—	—	—	36	5	2	303
Dumper, earth-moving equipment etc	1978	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
	1979	—	—	—	—	1	—	—	—	—	—	—	4	—	—	5
	1980	—	—	—	1	—	—	—	—	—	—	—	1	—	—	2
Powered goods vehicles	1978	2	—	2	15	2	14	—	5	—	—	1	19	2	—	62
	1979	4	—	—	14	3	10	1	3	—	—	—	19	—	—	54
	1980	2	—	1	7	1	10	1	1	—	—	—	9	1	1	34
Powered industrial and field vehicles NEC	1978	1	—	—	29	7	22	2	1	—	—	—	24	—	—	86
	1979	3	—	1	36	6	32	1	4	—	—	—	27	2	—	112
	1980	1	—	—	30	7	32	—	3	—	—	—	13	1	—	87
Non-powered vehicles	1978	4	—	32	162	63	110	10	109	2	—	—	6	2	2	502
	1979	4	—	22	137	36	91	7	112	—	—	—	5	2	—	416
	1980	4	—	19	100	27	98	1	76	—	—	—	—	3	—	328
Powered passenger vehicles	1978	1	—	—	2	1	1	—	—	—	—	—	2	—	—	7
	1979	3	—	2	2	—	1	—	—	—	—	—	7	1	—	16
	1980	2	—	—	6	—	6	—	—	—	—	—	6	—	—	20
Non-powered passenger vehicles	1978	3	—	1	—	3	1	—	—	—	—	—	1	—	—	9
	1979	2	—	—	2	—	—	—	1	—	—	—	2	—	—	7
	1980	3	—	—	1	1	1	—	—	—	—	—	—	—	—	6
Other transport	1978	—	—	—	2	3	1	1	2	—	—	—	—	—	—	9
	1979	—	—	—	1	1	1	—	—	—	—	2	—	—	1	6
	1980	—	—	1	4	3	2	—	—	—	—	—	—	—	—	12
Total (vehicles in motion)	1978	19	1	40	342	114	235	19	121	2	—	2	165	6	2	1068
	1979	26	1	25	315	38	194	13	129	—	—	3	149	6	4	933
	1980	15	1	24	267	63	251	2	90	—	—	—	65	11	3	792
Vehicles at rest																
Fork lift truck	1978	22	1	16	14	34	14	3	7	—	—	—	4	1	—	116
	1979	20	1	16	10	34	14	—	7	1	—	—	4	—	—	107
	1980	24	4	12	11	17	8	1	5	—	—	1	3	1	—	88
Dumper, earth-moving equipment etc	1978	1	—	2	—	1	—	—	—	—	—	—	1	—	—	5
	1979	1	—	—	1	—	—	1	—	1	—	—	—	—	—	4
	1980	—	—	—	—	—	—	—	1	—	—	—	—	—	—	2
Powered goods vehicles	1978	119	12	36	39	45	22	3	44	—	—	—	10	2	—	332
	1979	104	10	20	28	25	25	1	20	—	—	3	6	1	—	243
	1980	101	8	31	15	28	18	—	27	2	—	—	1	3	—	234
Powered industrial and field vehicles NEC	1978	2	1	3	3	2	6	—	2	—	—	—	2	—	—	21
	1979	4	1	4	2	4	8	—	3	1	—	—	5	1	—	33
	1980	4	—	4	5	4	3	—	2	—	—	—	1	—	—	23
Non-powered vehicles	1978	9	1	25	34	44	13	3	20	—	1	1	—	—	—	148
	1979	8	—	22	36	41	11	2	27	1	—	—	1	1	—	150
	1980	5	—	20	17	21	7	—	12	—	—	—	—	—	—	82
Powered passenger vehicles	1978	7	—	3	3	3	1	—	3	—	—	—	—	—	—	20
	1979	4	—	4	1	1	3	—	4	1	—	—	1	1	—	20
	1980	3	—	3	1	7	2	—	1	—	—	—	—	—	1	18
Non-powered passenger vehicles	1978	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2
	1979	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
	1980	—	—	1	—	1	—	—	—	—	—	—	—	—	—	2
Other transport	1978	1	—	—	1	1	—	—	—	—	—	—	—	—	—	3
	1979	2	—	—	1	1	—	—	2	—	—	—	—	—	—	6
	1980	—	—	3	—	3	2	1	—	—	—	—	—	1	—	10
Total (vehicles at rest)	1978	163	15	85	91	130	56	9	76	—	1	1	17	3	—	647
	1979	143	12	67	79	106	61	4	63	5	—	3	17	4	—	564
	1980	137	12	74	50	81	40	2	48	3	—	1	5	5	1	459
Total	1978	182	16	125	433	244	291	28	197	2	1	3	182	9	2	1715
	1979	169	13	92	394	174	255	17	192	5	—	6	166	10	4	1497
	1980	152	13	98	317	144	291	4	138	3	—	—	70	16	4	1251

^a Factories Act only.

Table 8 Bacon curing, meat and fish products industry: Accidents involving hand tools, 1978-80^a

Accident type	HAND TOOLS					
	Non-powered			Powered		
	1978	1979	1980	1978	1979	1980
Falls from heights	6	2	—	—	—	—
Falls on level	10	11	4	—	—	—
Struck by object or material	457	731	805	7	11	18
Striking against object or material	80	34	22	3	1	3
Caught in, under or between object or material	24	8	5	3	—	—
Rubbed or abraded by object or material	504	233	62	6	1	1
Overexertion, strenuous movements	30	17	83	4	1	1
Exposure to/contact with extremes of temperature or environmental conditions	1	1	1	1	1	3
Electric current	—	—	—	—	—	—
Exposure to harmful substances	1	1	1	—	—	—
Powered vehicle accidents	—	—	—	—	—	—
Accident type not elsewhere classified	7	1	5	—	—	—
Accident type not classified for lack of data	—	—	1	—	—	—
Total	1120	1039	988	24	15	28

^a Factories Act only.

Table 9 Prosecutions: Cases heard during the year, by industry, 1977-80

Sector	1977	1978	1979	1980
Grain milling	3	2	3	5
Bread & flour confectionery	23	21	29	16
Biscuits	3	2	2	3
Bacon curing meat & fish products	24	17	13	22
Milk & milk products	7	6	6	2
Sugar	—	2	3	2
Cocoa, chocolate & sugar confectionery	6	9	4	4
Fruit & vegetable products	9	4	8	5
Animal & poultry foods	3	8	4	10
Vegetable & animal oils & fats	3	4	—	1
Food industries not elsewhere specified	3	5	4	5

Table 10 Enforcement notices: number issued by type and industry 1978-80

Sector	1978				1979				1980			
	Improve- ment Notices	Deferred Prohibi- tion Notices	Immediate Prohibi- tion Notices	Total Notices	Improve- ment Notices	Deferred Prohibi- tion Notices	Immediate Prohibi- tion Notices	Total Notices	Improve- ment Notices	Deferred Prohibi- tion Notices	Immediate Prohibi- tion Notices	Total Notices
Grain milling	30	2	9	41	24	—	—	24	12	1	6	19
Bread & flour	—	—	—	—	—	—	—	—	—	—	—	—
confectionery	57	5	5	67	69	4	13	86	27	—	8	35
Biscuits	—	—	—	—	9	1	—	10	6	—	—	6
Bacon curing meat & fish	—	—	—	—	—	—	—	—	—	—	—	—
products	32	—	4	36	33	2	5	40	21	—	8	29
Milk & milk products	13	—	3	16	16	1	—	17	5	1	—	6
Sugar	2	—	2	4	3	—	2	5	—	—	—	—
Cocoa, chocolate & sugar	—	—	—	—	—	—	—	—	—	—	—	—
confectionery	19	2	2	23	21	—	2	23	12	1	2	15
Fruit & vegetable products	16	—	2	18	12	—	1	13	21	—	—	21
Animal & poultry foods	22	7	5	34	17	1	1	19	9	—	—	10
Vegetable & animals oils	—	—	—	—	—	—	—	—	—	—	—	—
& fats	5	—	—	5	10	—	—	10	3	—	—	3
Food industries not	—	—	—	—	—	—	—	—	—	—	—	—
elsewhere specified	19	—	3	22	17	—	5	22	6	—	—	7